The Electrical World.

VOL. XXVII. NEW YORK, JUNE 13, 1896. No. 24.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,
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THE ELECTRICAL WORLD,

253 Broadway, New York.

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NEW YORK RAPID TRANSIT.

The rapid transit problem in New York City has assumed, within the past two weeks, practically the same aspect as that which existed prior to the appointment of the Board of Rapid Transit Commissioners in 1890. The recent decision of the Appellate Division of the Supreme Court leaves the situation practically in the control of the elevated railway corporation, and it is now to this concern that New Yorkers must look for better transit facilities. The problem which presents itself differs but little from that obtaining in other cities, although the course of travel is in but two directions. Owing to the comparatively large number of short trains, the load throughout the system is uniformly distributed, which presents a condition most favorably met by electric traction, and it is safe to say that no other mode of propulsion will be adopted. Several companies now stand ready to sign a contract for the entire equipment which is sufficient evidence, if any were wanting, that no doubt exists as to the practical utility of electricity to the conditions presented. No better opportunity could be offered for the application of polyphase currents to electric traction, and if the conservatism of the Manhattan officials ever relaxes sufficiently to allow of a consideration of a change in motive power, it is not unlikely that polyphase currents and the induction motor will receive due attention.

ELECTRICAL CONSONANCE.

In an article on electrical consonance, which appears in this issue, it is interesting to see that the experimental results obtained by Mr. Chapman on a commercial transformer agree so well with those which theory predicts even though based on "ironless" mathematics. Electrical consonance suggests that ever fascinating but apparently delusive problem of over-compounding a transformer, but for which, however, it seems to offer no solution. In fact, it is extremely doubtful if any static method will be devised by means of which the secondary difference of potential may be made to increase with increase of load. The problem is somewhat analogous to that of raising one's self by the boot straps notwithstanding the fact that in the case of the direct-current transformer a rise in the secondary voltage with an increase in load can be produced. The difference lies undoubtedly in the independent control of the field in this type which cannot be attained in the static transformer unless perhaps by some inefficient method based upon magnetic leakage. Mr. Chapman treats simply of the phase relations between the primary E. M. F., primary and secondary currents and in this connection the most important deduction which he draws is that the primary current leads its E. M F. only between the two values of capacity in the secondary, producing consonance. Above or below these values the primary current lags behind the primary E. M. F. The statement that "the smaller the capacity the greater the lead of the secondary current," evidently is meant to apply only between the values of capacity just below that producing secondary resonance and just beyond upper consonance. In fact, even between these values the lead attains a maximum and then decreases with increase of capacity.

COLLEGE GRADUATES.

With the advent of the coming weeks there will at the same time be thrown upon the world thousands of young men starting on new and various careers in life, depending upon the selection of vocation determined upon some four years ago, and not a small part of this influx will consist of those who have chosen as their profession

electrical engineering. The opportunities then offered appeared more attractive than at the present day, and owing to the popular fallacy then existing that the most promising of all professions was that of the electrician, there resulted the adoption of courses in electrical engineering in all institutions having a pretext for such, with a corresponding increase in the number of applicants for admission. The business reverses of 1893 and 1894 failed to show any marked influence upon the number of applications, but, on the other hand, the size of classes gradually increased and the number of graduates have become more numerous. The opportunities offered for employment have, however, likewise increased, and with the erection of new central stations and railway plants, and the various opportunities offered in manufacture, the employment of educated engineers is gradually being recognized as essential, in order to meet both increased competition and provide better facilities for production. There exists in all phases of professional life a condition similar to that obtaining in the case of manufactured articles, a dependence between the supply and demand, and it is for this reason not necessary to look upon the crowding of professions from a pessimistic standpoint, as the conditions are sure to produce their natural sequence. Those institutions in which the several branches of engineering are taught have undergone the experience of having at first large classes in mining which were gradually superseded by the civil, and which, in turn, is apparently being superseded by the electrical. The importance of a training in mechanical engineering is also being recognized as the true basis of electrical engineering, and in those institutions where it is possible the dependence of one upon the other is continually becoming more marked. This will result in the acquirement of sufficient practical knowledge to fit the student more properly for the duties he is at first likely to assume after graduation, though it is, however, not necessary to lay too much stress upon this point, but rather to develop during his course of training the more profitable scope of his education, the applications of theory to practice.

BOILER EFFICIENCY.

It is universally accepted that the prime factor to be determined in a boiler test is the number of pounds of water evaporated per pound of coal. It is necessary, however, in order to draw comparisons between different tests to reduce the results to a uniform standard, such as "equivalent pounds of water from and at 212 degrees per pound of coal," or if allowance be made for ash and moisture, "the pounds of water evaporated from and at 212 degrees per pound of combustible." This necessitates two modes of expressing the efficiency, one being the ratio of the heat units imparted to the boiler per pound of coal to the number of heat units in a pound of dry coal by test, and the second being the ratio of the number of heat units imparted to the boiler per pound of combustible to the number of heat units in the pound of combustible by test. Owing to the fact that the determination of moisture is an uncertain factor, and for other reasons, the term "combustible" is one to be used with careful consideration. As the two methods of testing now employed—that is, by chemical analysis and by the calorimeter—lead to widely differing results, the term "efficiency" becomes an uncertain and indefinite expression. In a paper read before the American Society of Mechanical Engineers, Mr. Kent gives the results of some coal tests carried out by these two methods. The results show that with coal used as the basis of computation, the difference in efficiency is 6 per cent. for one coal tested by the two methods, and, on a basis of combustible, a difference of 7 per cent. existed. Still greater discrepancies are not uncommon, and are shown to each as high as 18 per cent. The results obtained with different calorimeters also differ widely, being as great as 2000 B. T. U. per pound of coal, causing a difference of about 12 per cent. in the efficiency. In fact, the results of tests given by Mr. Kent show possible efficiencies ranging from 56 per cent. to 85 per cent., depending upon the basis of computation and the method of testing the coal employed. Such results are sufficient to demonstrate that the efficiency of a boiler as above defined is a totally unreliable quantity. As the term is now quite generally employed it is essential that those making contracts involving its use should carefully see that the conditions for its determination are clearly specified. As Mr. Kent points out, a knowledge of the efficiency may be in certain cases desirable and of great value in the scientific study of comparative boiler tests for both the maker and the engineer, but it is more important to know the pounds of water evaporated per pound of coal under actual conditions than it is to know the efficiency, unless the latter be based upon a standard form of test.

THE STORAGE BATTERY IN TELEGRAPH OFFICES.

From one point of view it may be regarded as remarkable that the telegraph companies, by far the most conservative of electrical organizations, should lead in the use of the storage battery. Their conservatism, however, is a matter of necessity rather than one of choice or volition, for it is essential in the proper conduct of their business that the source of the electric current necessary to operate the lines must, first of all, be such that practically absolute dependence can be placed upon it. For many years primary batteries furnished the only means of obtaining current for telegraph work, and in large offices, like those of New York, Chicago, etc., as the business expanded, the question of battery space and maintenance eventually became a very serious problem. The necessity for a more satisfactory method of generating current in such offices was met in the adaptation of the dynamo to telegraphic requirements. While dynamo plants at large stations have proved both efficient and economical and displaced thousands of cells of primary battery, yet there are a very large number of places where it would not be economical to substitute a dynamo plant for batteries. In such, the storage battery meets an ideal field of application, and that its advantages are fully recognized by the telegraph officials is evident from the fact that their use in telegraph work is increasing rapidly. Some idea of the growing importance of the storage battery in its relation to the telegraph may be obtained from a few figures. Up to July, 1895, according to Mr. Maurice Barnett in an article on the use of storage batteries in telegraph work, which is printed elsewhere in this issue, 3116 storage cells of different capacities were at that time doing the work which formerly required 20,407 primary (gravity) cells to perform. The original cost of the batteries is given as $10,203.50, and that of the storage cells between $8400 and $8500. After adding to the latter figures the cost of the auxiliary apparatus necessary for the operation of the storage battery plant, the difference is still in favor of the storage battery. The advantages and economies are still further increased by the large saving in space. Output for output the primary battery requires four to six times more space than a storage battery, and space in most busy centres nowadays is easily resolved into its equivalent in dollars and cents. Another economy in favor of the storage battery plant is in the cost of maintenance. The primary battery such as is used in telegraph work is proverbially wasteful, yet its use has been tolerated because nothing better had been put forward to take its place, until the advent of the motor dynamo and the improved storage cell. The latter, as manufactured to-day, is a device far more reliable in service than formerly, and it is quite as much due to the certainty that a given cell will supply a definite output, as to the more weighty economies above referred to, that the storage battery is finding so much favor in this particular branch of electrical industry.

The Latest Trolley Decision.

On June 8 Judge Lacombe in the United States Circuit Court for the Southern District of New York handed down an opinion in the case of the Thomson-Houston Electric Company *vs.* the Union Railway Company, *et al.*, and Thomson-Houston Electric Company *vs.* the New York, Elmsford & White Plains Railway Company, *et al.*

Ten cars now in use on the Union Railway and four cars on the White Plains road are equipped with the Nuttall trolley, and the complainants sought an injunction to restrain the two companies from the further use of these trolleys and the use hereafter of any infringing combination covered by the claims specified.

Inasmuch, however, as the Nuttall Company had taken out a license for the manufacture and sale of trolleys covered by the complainants' patents, and as the papers did not show clearly that these particular 14 trolleys came within the provision of the license, Judge Lacombe decided that it was unnecessary to interfere with the use of the trolleys on these 14 cars, but granted an injunction forbidding the railway companies from hereafter using any infringing combinations unless they show that such combinations have been manufactured and sold under license from the owner of the patent.

The Walker Company is much pleased over Judge Lacombe's decision as far as it relates to the trolleys now in use. Since these cars do not come within the scope of the decision they are free from any legal restrictions.

The Walker Company says that the injunction as to the future use of the combination does not embarrass it in any way, as it has a non-infringing trolley ready to place upon the market, and there is, therefore, no necessity for it to use the Nuttall trolley in connection with the plants it will hereafter install.

The Kelvin Jubilee.

The programme of the Kelvin Jubilee is as follows: On the evening of Monday, June 15, at 8.30 o'clock, the University of Glasgow will give a conversazione, when there will be an exhibit of Lord Kelvin's inventions. On Tuesday, June 16, addresses will be presented to Lord Kelvin by delegates from home and foreign university bodies, from several of the learned societies of which he is a member, from student delegates from other universities, and from the students and graduates of the University of Glasgow. It is expected that the honorary degree of LL. D. will be conferred on the same day on several of the distinguished foreign visitors. On Tuesday evening, June 16, the city will give a banquet to Lord Kelvin, to which the visitors who have come to do him honor have been invited. On Wednesday, June 17, the senate of the university will invite the university staff to sail down the Clyde. The students of the university also invite the student delegates from other universities to a similar trip. Representative scientific men—about 50 in number—from America and the British Colonies, and from all the European countries, and about 150 from the United Kingdom have signified their intention to be present.

Electric Mountain Railway at Zermatt.

A company has been organized for the purpose of constructing an electric rack railway from Zermatt up the Gornergrat, Switzerland. This eminence is about 10,500 feet high and is a well-known point for obtaining a fine view of the surrounding Alps. According to the London *Electrician* the railway will be six miles long and will have an average gradient of 15 per cent. and maximum gradient of 20 per cent. Each train is to consist of two cars and to carry 100 passengers. The time of complete journey will be two hours. Power is to be obtained from the Findelen river. The total cost of the line is estimated to be about $700,000 and it is expected will be opened in 1898.

A Pacific Cable Bill.

Under the terms of the new Pacific Cable bill, to be favorably reported in the House of Representatives, the Postmaster-General in his discretion may contract with the Pacific Cable Company, of New York, for the construction of a cable between the United States, Hawaii, Japan and China *via* the Midway Islands. The bill grants the right of way over the United States land, and provides that the line may be controlled by the President in certain emergencies. One hundred thousand dollars is granted as a subsidy.

A Rhone Water-Power Plant.

The construction of a large water-power plant, to be utilized in supplying electrical energy to the City of Lyons, is being carried out, and will, when completed, aggregate about 20,000 horse-power. The works, it is stated by *Engineering*, London, necessitated the construction of a canal 18,600 metres in length. The canal is provided with locks, and will be utilized at the same time for purposes of navigation. The company is allowed to draw 100 cubic metres per second, and may at times increase the amount to 150 cubic metres, when the total discharge of the Rhone equals 600 cubic metres. It occasionally happens that the entire flow of the river is reduced to 130 cubic metres, which would leave a balance of but 30 cubic metres for power purposes. Such diminution, however, is rare, and after the completion of the works the new canal should have a uniform depth of 2½ metres. The company, according to law, must lay the service connections for every customer making a three years' contract, providing that the amount of current taken has a total rental value equal to one quarter of the cost of giving the service. The wires and cables must be laid beneath the sidewalks in conduits of pottery, masonry or metal. Current sold for motive power is to be reckoned in horse-power units of 75 kilogrammetres measured on the meter at the house of the subscriber after transformation if transformers are employed, at the rate of 736 watts per horse-power. The tariff fixed is .027 of a franc per hour, or 72 francs ($14.50) per year for each .1 of a horse-power for a motor up to 1 horse-power. For a 4-hp motor it is .24 of a franc per hour. For higher powers the reduction is also progressive until it reaches 50 horse-power, when the charge is 250 francs ($50) per annum. The company is not obliged to furnish any subscriber with more than 50 horse-power. At the present time the tariff for electric lighting has not been settled.

The power-house consists of a basement and two upper stories. In the basement the discharge openings from the turbines converge in the tail-race. The first story above contains the turbines and in the upper floor are placed the generators. Each turbine is coupled direct to a dynamo. It is expected with a fall of 12.2 metres and a turbine efficiency of 75 per cent., there will be developed with a water discharge of 100 cubic metres a total horse-power of 12,200. It is anticipated that there will be available during 253 days of the year and for 19 hours of each day a power of 12,100, with an addition of 7500 horse-power during nine hours. Each turbine will drive a polyphase generator of 1000 horse-power. Current will be transmitted through six main cables and the effective voltage will be about 5500.

There will be two sub-stations, one of which will transmit 150 kilowatts to consumers of small power at 110 volts. The other will be employed for distributing 400 kilowatts for electric lighting. The total cost is estimated at 24,000,000 francs ($4,800,000), of which about half is expended in earthworks and masonry. Upon the success of the present undertaking will depend the construction of another power station on the Rhone, for which a provisional authorization has been obtained.

Relative Utility of City Railways.

Our Austrian contemporary, the *Zeitschrift fuer Elektrotechnik*, gives the following table showing the number of rides on passenger railways taken per year by each inhabitant in a number of cities:

In New York	267
In Berlin	140
In London	116
In Hamburg	90
In Paris	84
In Budapest	59
In Vienna	46
In Prague	22

From this it might appear as though New Yorkers were the laziest because they ride so much, but the true explanation is that they "hustle" more than the foreigners do.

Quick Work by the Cable.

It is reported that the United Press furnished to every newspaper supplied with its service in the United States the announcement that Persimmon had won the Derby at Epsom Downs before the winner had ceased his galloping stride and a blanket had been thrown over him. The first letters of the word Persimmon were received in New York City before the transmission of the full word had been accomplished by the operator at Epsom Downs.

Notes on Electrical Consonance.

BY A. W. CHAPMAN.

Some months ago I had occasion to work upon a problem which involved the use of a condenser in the secondary member of an alternating-current circuit.

While considering the subject, I referred to Prof. Pupin's paper on "Electrical Consonance" in The Electrical World, Feb. 9, 1895, and also to Mr. Steinmetz's article on the same subject in The Electrical World, March 2, 1895. The latter article, while putting the matter

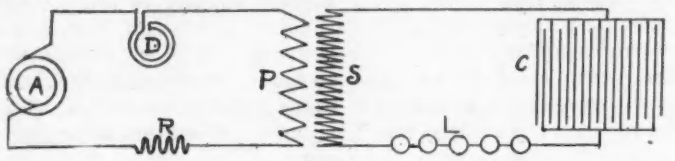


Fig. 1.

in a very simple light, contains statements which seem very misleading.

He states that at complete resonance the secondary E. M. F. and secondary current are in phase, while the primary current lags a little, due to its magnetizing component. "To bring it into phase the secondary current must be made to lead so much that the leading component of the secondary equals and thereby neutralizes the lagging component of the exciting current. . . . Obviously it requires a larger capacity in the secondary circuit to make the current leading than to bring it merely into harmony with the E. M. F." I think, on the contrary, it can readily be seen that the smaller the capacity the greater the lead of the secondary current. A capacity small as compared with that necessary to neutralize the inductance, will allow a small current to flow which will lead its E. M. F. As the capacity is increased more and more, the current becomes larger and ceases to lead so much, as the inductance begins to come more into prominence. Finally the current and E. M. F. become coincident in phase, and then, as the capacity is still increased the current begins to lag, until at in-

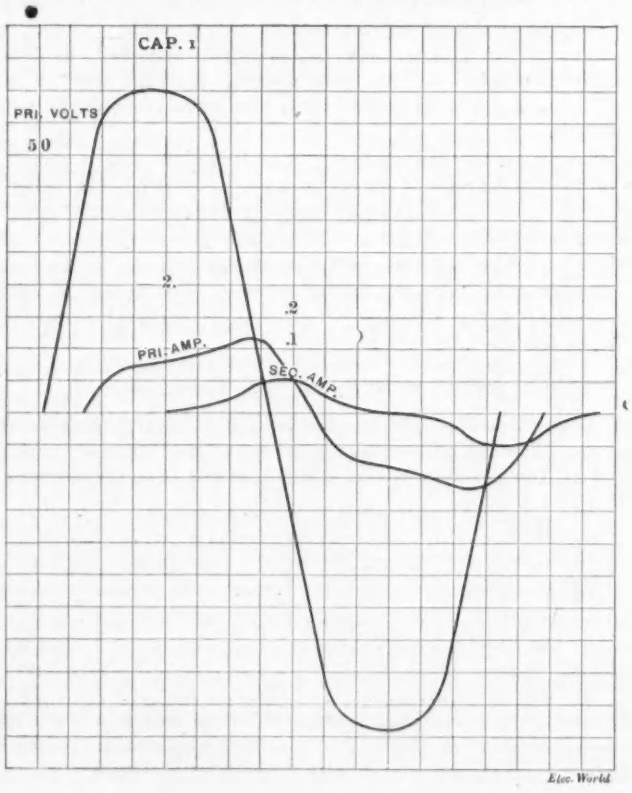


Fig. 3.—Below Resonance.

finite capacity, or when the condenser is short-circuited, the current lags to the degree required by the reactance.

If we denote by the term secondary resonance that condition in which the self-induction of the secondary circuit and its capacity neutralize one another, or, using the notation of Prof. Pupin, when $\frac{1}{p^2 C} = N$, where $p = 2\pi n$, n being the number of complete periods per second, C and N being the secondary capacity and inductance respectively, we will find that at resonance the secondary E. M. F. and secondary current are generally far from being in phase, the secondary current leading the secondary E. M. F. The relations and phases of the currents are easily found from the equations given by Prof. Pupin in his article. Taking the primary E. M. F. curve

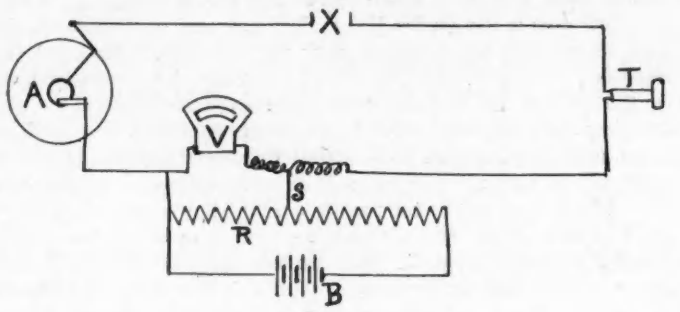


Fig. 2.

as a reference curve, the secondary E. M. F. will be 180 degrees behind.

Let M be the mutual inductance,
L the primary inductance,
R the primary resistance,
S the secondary resistance,
φ_1 angle of phase difference between primary current and E. M. F.

This phase difference is given by the expression $\tan \phi_1 = -\frac{pL^1}{R^1}$, where L^1, which is the apparent inductance of the primary

$$= L + \frac{p^2 M^2 \left(\frac{1}{p^2 C} - N\right)}{p^2 \left(\frac{1}{p^2 C} - N\right)^2 + S^2},$$

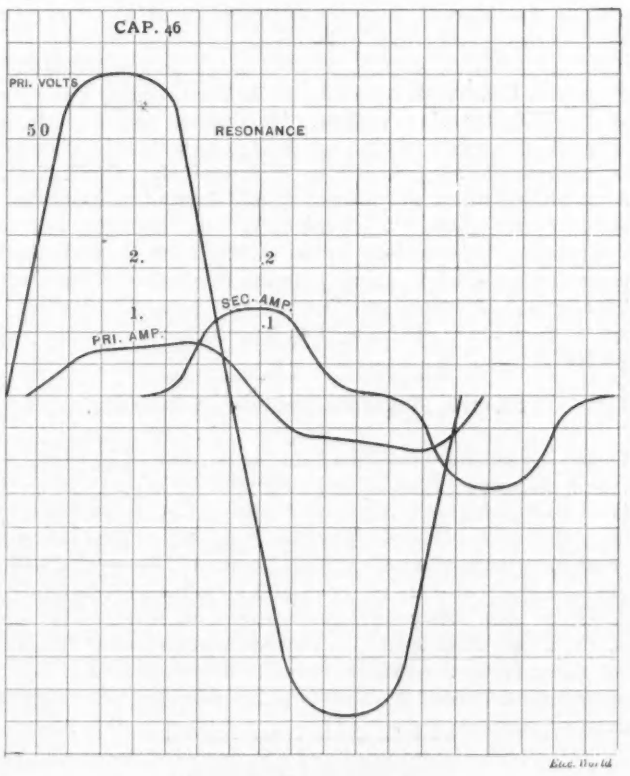


Fig. 4.—At Resonance.

and R^1, or the apparent resistance

$$= R + \frac{p^2 M^2 S}{p^2 \left(\frac{1}{p^2 C} - N\right)^2 + S^2}.$$

Let ϕ_2 be the angle of phase difference between secondary current and primary E. M. F.

These are the ordinary equations of the transformer, except that for N we have now $\left(\frac{1}{p^2C} - N\right)$. From the equations it is also very easy to obtain $\tan(\phi_1 - \phi_2) = -\frac{S}{p\left(\frac{1}{p^2C} - N\right)}$ which gives the difference in phase between the two currents. To find the influence of the capacity in the secondary on the phases of the currents, etc., suppose, other conditions remaining the same, a small amount of capacity be inserted, so that $\frac{1}{p^2C} > N$. This makes $\frac{1}{p^2C} - N$ a positive quantity. The primary current will lag behind its E. M. F. and the secondary current behind the primary current, but the secondary current will be less than 90 degrees behind the primary, as $\tan(\phi_1 - \phi_2)$ will be of negative sign and of finite value.

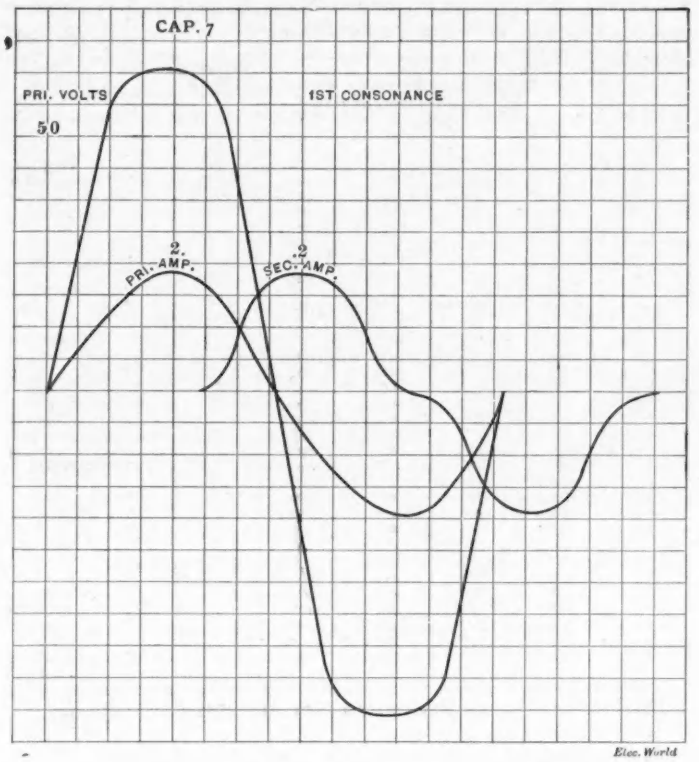


FIG. 5.—AT LOWER VALUE FOR CONSONANCE.

Now suppose C is increased until $\frac{1}{p^2C} = N$ or secondary resonance is obtained. The second member of L^1 becomes o, but the primary current will still lag. $\tan(\phi_1 - \phi_2) = -\infty$, showing that the secondary current will now be exactly 90 degrees behind the primary current, and hence ahead of its E. M. F.

Increasing C still more, the first point of consonance is reached which occurs when

$$\left(\frac{1}{p^2C} - N\right) = -\frac{1}{2pL}\left(p^2M^2 - \sqrt{p^4M^4 - 4L^2S^2}\right)$$

a negative quantity of small numerical value. The primary current and E. M. F. will now be in phase, and the secondary current will lag somewhat more than 90 degrees behind the primary current, but is still far from being 180 degrees behind it.

Again increasing C, but not sufficiently to give the second point of consonance, the term pL^1 becomes negative, making $\tan\phi_1$ positive, which shows that the primary current now leads its E. M. F. in phase; the secondary current will be less than 180 degrees behind the primary current and hence must lead the secondary E. M. F.

With more capacity the upper point of consonance is reached, when the primary current and E. M. F. are again in phase. $\tan(\phi_1 - \phi_2)$ is still a negative quantity, showing that the secondary current still leads its E. M. F.

Increasing the condenser from this point causes pL^1 again to become positive. The primary current now lags again and the secondary may assume the phase of the secondary E. M. F., and as C is further increased, lag behind it.

Thus it is seen that the primary current in a transformer lags behind the primary E. M. F. for all values of capacity in the secondary, except those lying between and including the values necessary for consonance, under which conditions the current is in phase at the limits and leads within these limits.

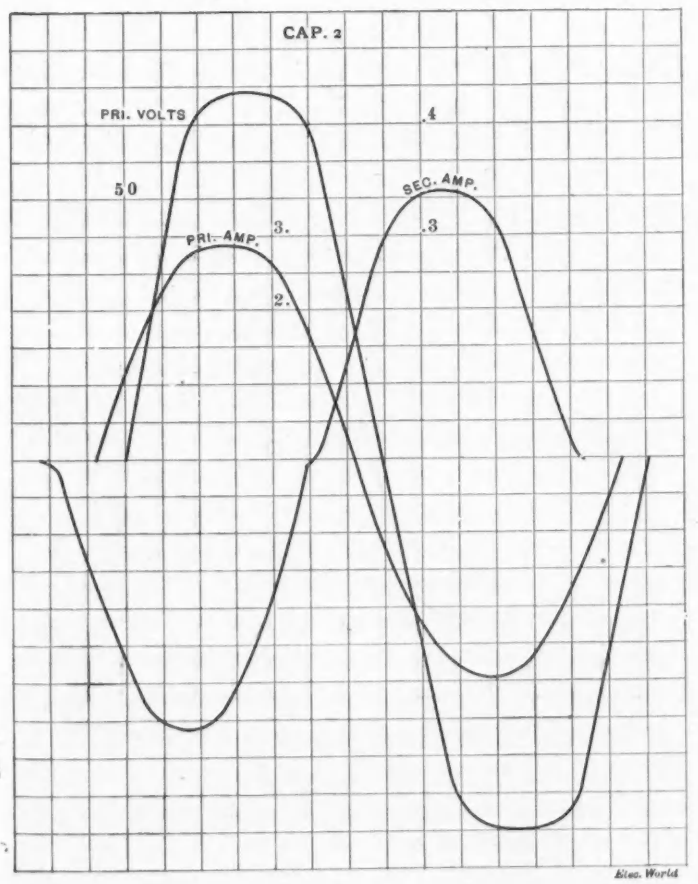


FIG. 6.—BETWEEN LIMITING VALUES FOR CONSONANCE.

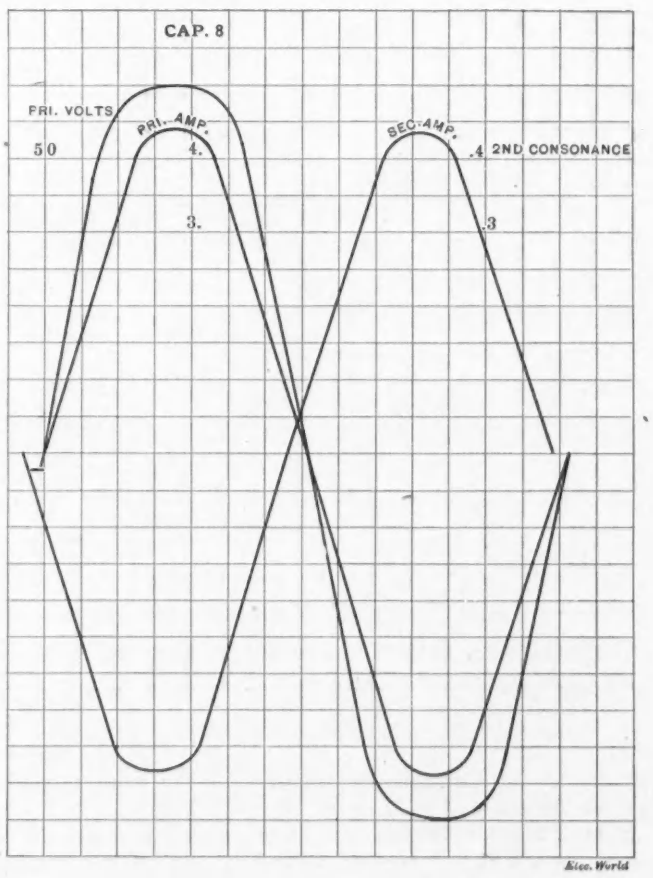


FIG. 7.—AT HIGHER VALUE FOR CONSONANCE.

Under many circumstances the quantities are such that electrical consonance or coincidence of phase between the primary current

and primary E. M. F. is impossible. In this case, of course, the primary current always lags behind the primary E. M. F., no matter what the value of the capacity may be.

As means were available for verifying these deductions, an experiment was undertaken for this purpose.

A small six-pole alternator, *A*, Fig. 1, fitted with a contact disc for obtaining instantaneous values of E. M. Fs., was connected to the low-tension side of a 25-light transformer of a well-known make, indicated at *P*. A small amount of non-inductive resistance, *R*, was included to get the current phase, and a dynamometer, *D*, to measure its value. The secondary circuit consisted of the high-tension side of the transformer, *S*, a few lamps in series, *L*, and a condenser, *C*. The machine was run at a speed of 1200 per minute, giving a frequency of 60 periods, and was kept at a constant voltage of 50 volts.

The method of obtaining the phases and the curves was the well-known one with a telephone receiver, by balancing the instantaneous E. M. F. at the contact point against a constant direct E. M. F. A diagram of the connections is shown in Fig. 2. *A* represents the contact disc of the machine, *X* the E. M. F. which is being determined, *T* the telephone receiver, *R* a resistance which is traversed by a direct current from a source *B*, and *S* a slider by means of which the direct potential in the contact circuit is varied. A voltmeter *V* reads this potential directly. When the phase only is to be determined, the direct potential is not necessary, as the contact point is set until the telephone is silent, which gives a zero point of the wave. For every adjustment of capacity the primary current was read from the dynamometer; the phase of the primary E. M. F. was taken from the machine, of the primary current from the non-inductive resistance *R*, of the secondary current from one of the lamps. The phase of the secondary E. M. F. was not taken at every adjustment, as its potential was rather high, but it was frequently taken, and was always found to be nearly 180 degrees from the primary, within two degrees on either side. The readings are given in the table herewith.

In order to determine the form of the waves, complete curves of the currents, both primary and secondary, and of the primary E. M. F., were taken at different adjustments. The complete secondary E. M. F. could not be taken, as no direct potential sufficiently high was available. In the curves shown it is plotted from the primary E. M. F.

As will be seen from the curves, the E. M. F. wave is a smooth one with rather a flat top. At higher excitation this machine gave a peaked wave, while at lower excitations a dip appeared in the crest

TABLE.

Capacity Mfds.	Primary Current Amperes	Scale Readings for Phases. Primary E. M. F.	Primary Current	Secondary Current.	Primary E. M. F.	S	
0	1.1	300°	336°	400°	50	60	Magnetizing current
.01	1.	300	335	400	"	"	
.03	1.	300	333	400	"	"	
.05	1.	300	332	400	"	"	
.1	.96	300	330	400	"	"	
.15	.92	300	328	400	"	"	
.3	.87	300	324	402	"	"	
.4	.82	300	320	405	"	"	
.5	.87	300	310	408	"	"	Resonance
.6	.96	300	308	410	"	"	
.7	1.05	300	302	415	"	"	First consonance
.85	1.17	300	288	418	"	"	
.95	1.3	300	280	420	"	"	
1.1	1.4	300	278	424	"	"	
1.35	1.84	300	272	430	"	"	
1.5	2.	300	270	432	"	"	Maximum lead of primary current
1.8	2.5	300	272	435	"	"	
2.15	2.8	300	275	438	"	"	
2.35	2.9	300	275	440	"	"	
2.8	3.2	300	280	442	"	"	
3.6	3.45	300	282	448	"	"	
4.15	3.6	300	285	450	"	"	
4.7	3.7	300	288	452	"	"	
5.3	3.85	300	290	453	"	"	
6.	4.	300	294	458	"	"	
6.5	4.1	300	295	458	"	"	
7.	4.12	300	297	460	"	"	
8.	4.22	300	299	463	"	"	Upper consonance
10.	4.28	300	302	467	"	"	
14.3	4.4	300	305	470	"	"	
18.	4.5	300	305	474	"	"	
∞	4.2	300	310	482	"	"	Condenser short cir.

The curves were taken at seven different values of capacity.
1st: Below resonance.
2d: At resonance.

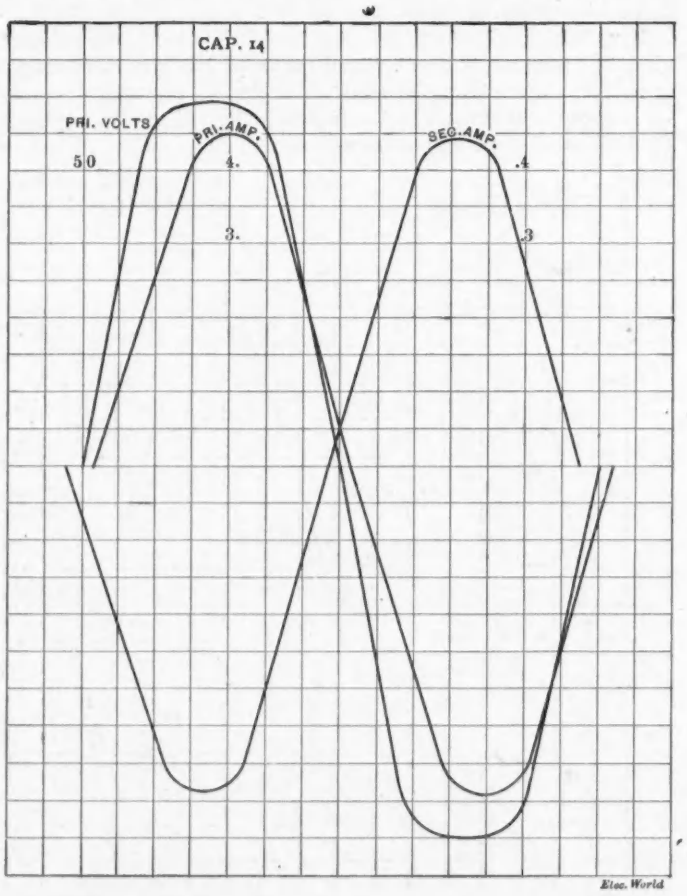


Fig. 8.—Above Higher Value for Consonance.

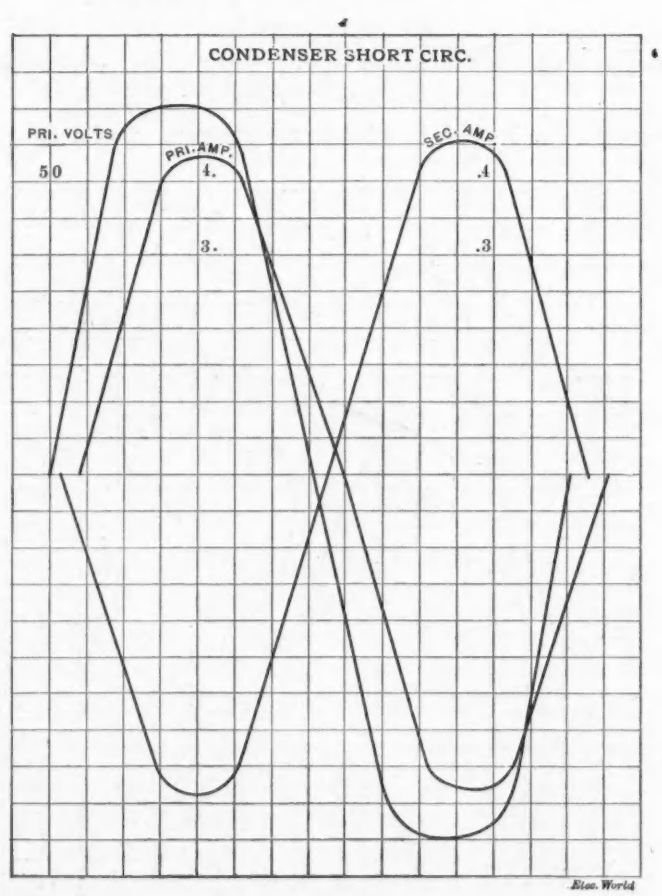


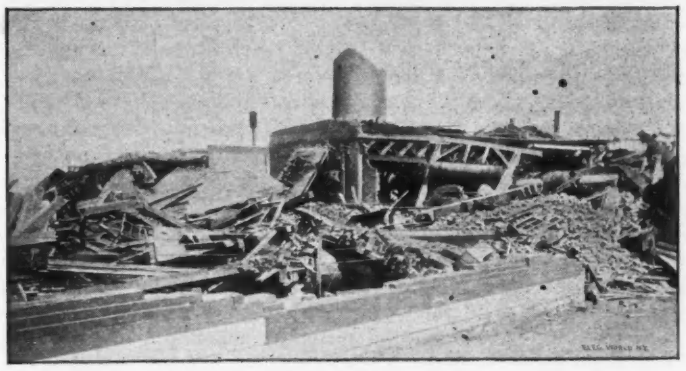
Fig. 9.—With Condenser Short Circuited.

3d: At the lower value for consonance.
4th: Between the limiting values for consonance.
5th: At the higher value for consonance.
6th: Above the higher value for consonance.
7th: With capacity short-circuited.

These results show clearly, I think, the effect of capacity in the secondary of a transformer, and that the primary current may be made to lead its E. M. F. for only a limited range of capacities in the secondary.

Some Effects of the Tornado at St. Louis.

The Union Depot Railway Company has been a heavy sufferer from the disastrous tornado which recently visited St. Louis. This company has lines covering 73.71 miles of track which are operated in seven divisions from two power-houses. In certain cases they operate over other tracks for short distances, and, in some cases, pay for power as well as for the use of the tracks. In some places separate overhead line is installed, so that there is a double set of poles and two trolley wires. The managing official of the company is Mr. Harris Scullin, vice-president and general manager.

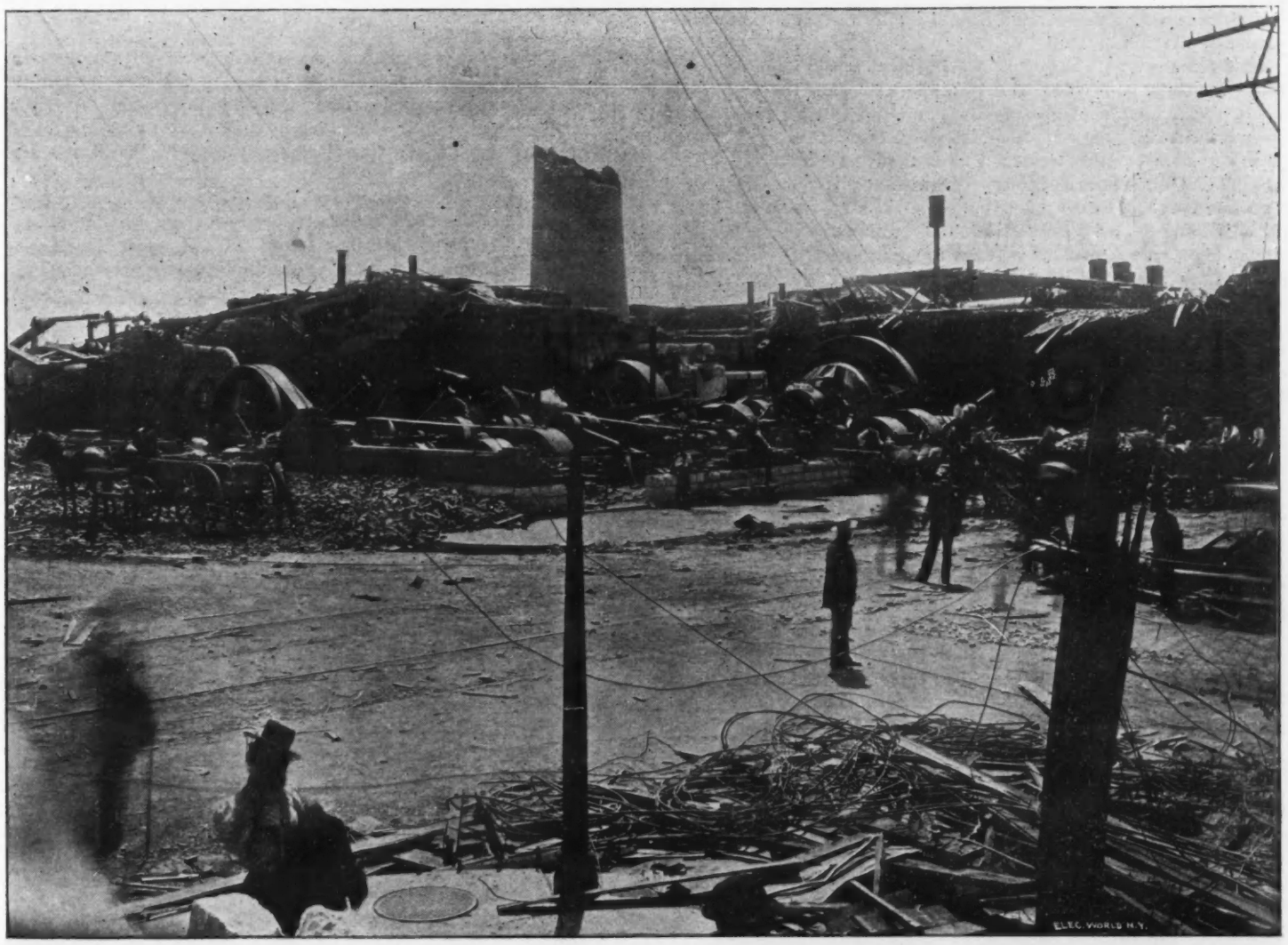


UNION DEPOT RAILWAY COMPANY'S BOILER HOUSE.

The system is laid with a 78-pound 6-inch Wharton girder, with tie and brace-plates alternating on each tie. The ties are 6 x 6 inches by 8 feet, and are placed two feet apart on a crushed stone foundation. This system was operated from two power-houses, known as No. 1 and No. 2, and the power-house we illustrate as devastated by the tornado is No. 1.

The engine equipment originally consisted of two Hamilton-Corliss engines, one of 250 horse-power and the other of 350 horse-power, which was belted to a jack shaft driving a line shaft from which eight Thomson-Houston bipolar generators of 80-hp capacity were driven. Subsequently two 28 x 50 engines of 600 horse-power of similar type to their predecessors were installed in a similar manner and belted to 18 80-hp generators. Following this two 570-hp direct-coupled units were installed. The generators were of 400-kw capacity and were supplied by the General Electric Company, while the engines were of the well-known Porter-Allen type. Still another equipment consisted of a 36 x 48 Allis engine, which easily indicates

UNION DEPOT RAILWAY COMPANY'S CAR SHEDS.



UNION DEPOT RAILWAY COMPANY'S POWER HOUSE.

1300 horse-power. This engine ran at 100 revolutions, and was coupled to an 800-kw General Electric generator. Two more Allis engines 36 x 60 each, coupled to a 1500-kw generator, were installed, replacing the bipolar system. The boiler equipment consisted of 13 Heine boilers, of which 11 were rated at 250 horse-power, and the other two at 500 horse-power. They were connected to two stacks, one of iron and one of brick. The brick stack measured 27 feet at the base and 15 feet at the top, and the iron stack measured 180 feet in height. The destruction of both stacks was complete, and the station was generally demolished, as shown in the two views of the photograph.

The company's car barns as shown in the accompanying illustration were reduced to a pile of boards and rubbish. At the power-house four men were killed. E. H. Zimmer, chief engineer, two repair men and one visitor.

The Union Depot Railway Company has suffered severely in the destructive effects to valuable property. From these two instances it will be seen that the cyclone has not spared it. It is sincerely to be hoped that the damage is merely one to the building, and that most of the machinery is intact. This company has been one of the most energetic and enterprising in St. Louis and is deserving of all the sympathy and assistance of its fellow companies in other cities, and even of its competitors at home.

Central-Station Working—XVII.

Looking to Future Requirements.

BY F. A. COPELAND.

Of the many varieties of station equipment in use a large per cent. are not only out of date but uneconomical in operation. Very few of the stations built several years ago are well arranged to give good economy, and it now necessitates careful judgment to plan a station that will give the best results, and at the same time anticipate future requirements.

At the time we built the electrical business was in its infancy and very little could be learned from the experiences and trials of others. There was already in operation a Brush arc light station, so that only incandescent lighting was adopted, the Edison three-wire direct-current system being selected. The station was constructed with a very liberal allowance for future growth, and it has since proved fortunate that this was done. A lot some 150 x 150 feet was secured, on which was erected a substantial brick building of one and a half stories high, with a one-story boiler room in the rear. The engine and dynamo room is 50 x 80 feet, finished in oak, and kept as neat and clean as possible.

The first installment of machinery consisted of two Taylor-Beck high-speed engines, each belted to two Edison No. 20 bipolar dynamos, and placed at the end of the engine room nearest the boilers.

In a few years the increase of load, and especially the motor load, necessitated the addition of a smaller engine and two No. 10 dynamos. By this arrangement it was possible to carry the load in the most economical way, by keeping one or two engines at nearly full load and having no line shafting to waste power.

This equipment occupied only one half of the space in the engine room, so when last year it became necessary to further enlarge the generating capacity the extra space suited the required conditions perfectly.

After a careful study of the fine points of modern and improved machinery, together with the requirements of the station, it was decided to install a larger unit with the least possible waste in power, with the result that the outfit is giving splendid satisfaction both in economy and perfection of operation. It is composed of a Ball tandem-compound condensing engine of 225 horse-power, directly connected with two General Electric multipolar generators of 75-kw capacity and 125 volts each, and a speed of 275 revolutions per minute.

One would think that a unit of this size running at 275 revolutions would shake to pieces, but when it is in operation we are reminded of these thoughts of Emerson's in regard to manners: "A beautiful form is better than a beautiful face; a beautiful behavior is better than a beautiful form; it gives a higher pleasure than statues or pictures." Upon changing over from the belted machines to this direct-connected unit, one is under the impression that the station has shut down, so noiselessly does it run.

At this time our thoughts were turned toward a new field for electric lighting; to a portion of the city out of the reach of our direct current, a district favored only with a supply of poor gas. To reach these neglected inhabitants the alternating current was necessary, so a G. E.-monocyclic 2300-volt generator was decided upon. Just how to run this machine was a puzzle until we hit upon the happy (or foolish) thought of connecting it directly with a motor, or rather coupling the shaft of a large motor to the shaft of the generator, and furnishing current to the motor from the bus-bars of our direct-current system. Upon first thought this may seem to be a wild scheme, but now that we have had it in operation several months, and have had an opportunity to see its good and its bad points, the good points predominating, we are more than pleased, especially as we feel that the idea is original, and you all know what a satisfactory feeling this is. The alternator is a 2000-light machine, and the motor a 100-hp 250-volt 4-pole, running at 900 revolutions.

The advantage of this arrangement is a minimum loss of power, as there are no belts, and the load on the alternator only serves to load the engine, or engines, already in operation, to an economical point, and it also saves the necessity of running an extra engine for this machine.

Whenever it is necessary to start the alternator a simple throwing in of the motor switch and moving of the rheostat lever and the power is on. By placing an ammeter in the circuit with the motor a glance will show exactly what power is used in running empty, and by throwing in your station switch and line switches a simple subtraction of readings show exactly what load is being carried. If this is done before any lights are turned on it shows the leakage on the line, and is a very easy and accurate way of indicating the latter.

With this arrangement we are not dependent upon one engine, it being immaterial which engine is furnishing power; we have a sufficient amount of reserve power at all times.

The plant is run 24 hours each day and furnishes 95 arc lamps, 13,000 incandescent lights and 250 horse-power in motors. It also furnishes electricity for heating and cooking, and the service given in every department is satisfactory.

The line was also constructed with the same idea of future growth in view. Heavy copper feeders were run in all directions with mains branching off, and these connecting together at the terminals so that they feed into each other, and in case of an extra amount of current being used in any one locality the line in that locality is helped out by the others.

When we started our station we were advised to adopt the contract system, but after two years' trial we were convinced that we were wrong, it being continually a heavy load and small receipts, so we changed to the meter system. Of course we lost some customers, not enough to reduce our gross receipts, but which reduced our load very materially, and the saving in fuel was quite noticeable.

We are now competing with gas at $1.25, and manage to increase our business at ¾ cent per hour for 16-cp lamps, and as we believe in giving our customers all we possibly can for their money, we are in hopes to reduce our prices in the near future.

For the Relief of Drawbaugh.

On June 3 the United States Senate Committee on Patents made a favorable report on the bill for the relief of Daniel Drawbaugh. It directs the Commissioner of Patents to issue to Daniel Drawbaugh a patent or patents for the inventions of improvements in telephony described and claimed in pending applications filed by Drawbaugh in the Patent Office at various times from 1880 until 1884, notwithstanding that said inventions may have been in use or on sale for more than two years prior to the date of the filing of Drawbaugh's original application of July 26, 1880. These patents, when issued, are to have the same effect as though no delay had occurred in presenting or prosecution therefor, and each patent when so issued is to be good in law to secure to the owner the sole right during its term to the exclusive use, make and sale of such patent invention. A proviso gives all persons having apparatus containing any of these inventions in use at the time of issuing such patent the right to continue the use of such apparatus without charge or molestation; and no one is to be liable to Mr. Drawbaugh for any manufacture, use or sale of Drawbaugh's inventions occurring prior to the issuance of the patent or patents authorized in the bill.

Rumor Denied.

The report that Morton, Bliss & Co., New York, had acquired the plant and privileges of the Niagara Falls Hydraulic Power & Manufacturing Company, paying therefor $4,000,000, is stated by the firm to be absolutely untrue.

The Storage Battery in Telegraph Work—I.

BY MAURICE BARNETT.

There is, perhaps, no field for the employment of storage batteries that holds out greater possibilities from a practical, scientific and economic point of view than that monopolized by the primary battery since the incipiency of the telegraphic art. For telegraph and telephone stations, fire-alarm, police telegraph, burglar-alarm and heat-regulating systems storage cells, where current is available for charging purposes, have an almost ideal application. Their low first cost, their very small maintenance cost, the constancy of current and pressure furnished by them, their freedom from liability to break down, the fact that numerous circuits may be operated from the same storage cell, the further fact that irregularities on one circuit will not affect other circuits, combined with the fact that but little floor space and little attention is required by them, pre-eminently adapt them for this kind of work.

As was to be expected, the advent of the storage battery into this field was long delayed—which accounts, perhaps, for the fact that when its advent was finally made its success was instantaneous.

There is something about telegraph, telephone and fire-alarm systems that militates against the introduction of new apparatus. What is wanted here is absolute reliability and certainty. Large first cost, cumbersomeness and even temporary irregularities can be tolerated if only freedom from breakdown can be predicted. The primary cell had many characteristics which made it valuable for this work. It had at least been tried; and, while not a perfect apparatus, had met requirements. When the storage battery first knocked at the portals of the telegraph office it had not achieved marked success in the applications made of it. Consequently the electrician of these quasi-public corporations looked askant at the new invention; its elements of weakness and uncertainty justified them, they thought, in refusing to have aught to do with such a battery. As a matter of fact, as MacRae has said, "the poorest type of lead battery that had been on the market in this country was capable, if properly installed, of giving better service for the class of work above mentioned than the best type of primary battery." This, however, did not count; the battery was new and, as was foreseen, it was condemned.

How different is the situation now! One can scarcely take up an electrical journal without finding mention of some new installation of storage batteries for telegraph work. At every convention of railway telegraph superintendents the economy of replacing primary cells by storage batteries is a frequent theme of the speakers – and there is no adverse discussion. Only last year the largest manufacturer of fire-alarm and police-telegraph apparatus in the United States determined to introduce storage batteries with every new plant, and to recommend their adoption in existing systems using primary cells. In the past two years the Western Union Telegraph Company has thrown out about 30,000 primary cells, and replaced them with storage batteries. The Postal Telegraph Cable Company, while not so quick in exploiting the use of secondary cells, has made some notable installations in Baltimore, Md., and Albuquerque, N. M. While it used to be the rule to find those who would scout the idea of replacing primary by secondary cells in telegraph installations, it is now the exception to find any one who questions the superiority of the latter apparatus for this kind of work.

Great as this change has been, it has come about solely through the self-interest of telegraph, telephone and other companies in settling on a battery that would give the best results in practice under any and all circumstances. In the test to which storage batteries were put, they showed their superiority in so pronounced a way as to leave no doubt that at last an efficient, reliable, economical and advantageous substitute for primary batteries had been found. The determining factors leading to the replacement of primary by secondary batteries were (1) the lower first cost, (2) the lower maintenance cost, (3) the smaller floor space required, and (4) the more satisfactory performance of the accumulators. The value of the two classes of batteries in these particulars will be evident after very little reflection.

Of the various methods open of arriving at the relative first cost of these cells, the most satisfactory will be to ascertain the cost of the secondary batteries in one or more telegraph offices, and compare that with the cost of the primary cells which they displaced. In a monograph on "Storage Batteries in Telegraph Offices," which is a reprint of articles in *The Telegraph Age*, there is a table which shows the number and ampere-hour capacity of "Chloride," accumulator cells in certain Western Union offices, and the number of primary cells which had previously been required for performing the same work. A comparison of columns (1) "Number of Accumulators in Use," and (2) "Number of Gravity Cells Displaced," shows that 3116 storage cells of different capacities were, at that time (July, 1895), actually performing the work which previously required 20,407 primary battery cells. The price of the latter, when cells are bought in large number, is 50 cents per cell. This would make the cost of the primary batteries $10,203.50. The cost of the accumulators as near as can be ascertained, was between $8400 and $8500. If the element of freight were figured in these costs, the difference would be still greater, for the weight and bulk of the 20,407 primary battery cells were very much larger than that of the 3116 storage battery cells which displaced them.

The above costs are for the batteries complete. Accumulator installation, however, requires certain auxiliary apparatus which will, to a slight degree, alter the relative costs as given above. What this apparatus will consist of will depend upon the nature of the current used to charge the storage battery. This current may be from a trolley circuit at 500 volts, from any incandescent circuit on the three-wire system, from any ordinary incandescent or arc circuit, and lastly, from a dynamo plant specially installed to furnish current for charging the battery and not intended to be used for any other purpose. This last is a very extreme case which has not been met with - so far as the writer knows—and need not be considered in this connection. In the first three instances some apparatus will probably be needed to reduce the potential of the charging current to the requirements of the office. Whether this apparatus will consist of a motor-generator or other machinery, resistance such as that afforded by lamps, rheostats, counter E. M. F. cells, etc., will depend on the conditions governing each case. For installations where the desideratum is to consume current with smallest possible loss, a motor-generator of high efficiency (or a rotary transformer in case of alternating currents) would be employed. If the amount of current used in charging were exceedingly small and the question of economical transformation did not need to be considered, lamp or wire resistance would be employed. The advantage of lamp resistance is that, besides constituting the cheapest form of current equalizer, the resistance may be utilized for lighting purposes. This is done by the Western Union Telegraph Company at its Allentown, Pa., office. Other apparatus needed would consist of switches and recording instruments.

While it is difficult, for obvious reasons, to ascertain the relative cost of storage batteries and accessory apparatus, experience shows that 15 per cent. of the cost of the battery will, in most cases, cover the cost of the accessory apparatus. Even with this amount charged to accumulator construction, the cost of this is well within that of primary batteries. Primary batteries, on the other hand, require from four to six times the space required by accumulators - which further increases the cost of this kind of construction so far as the stands are concerned, so that in any comparison of costs between the two systems, the advantage is entirely on the side of the storage battery.

Taking up now the second point, *i. e.*, the question of relative maintenance cost of primary and secondary batteries, it must be said that the statements of those competent to speak authoritatively upon the subject, differ widely as to the cost of material consumed yearly in a gravity cell, the uniform type of primary battery found in telegraph offices. William Finn, whose articles on "The Storage Battery in Telegraph Offices" constitute the most valuable literature that has thus far appeared on this subject, says: "The materials consumed in a single cell of the gravity battery furnishing current for a quadruplex circuit, would, in the course of a year, amount, *at the lowest* estimate, to $1.10. J. B. Stewart, Superintendent of Telegraphs of the West Shore Railroad Company, in a paper read at the Convention of the Association of Railway Telegraph Superintendents, held at Montreal, Quebec, June 12 and 13, 1895, put the cost of maintenance of the gravity batteries used in the "West Shore" railway telegraph system at $1.65 per annum. Other authoritative statements bearing on this question fix the cost of maintenance of gravity cells at $1.50 a year, which, in all probability, is an average figure that will be found correct for most offices.

The cost of maintaining accumulators is made up of several factors, namely the cost of charging current, the interest on first cost of cells and the depreciation of cells. If the charging current be bought from an electric light company it will cost more, naturally, than if it were furnished by the regular light or power plant at the telegraph station, in which latter case it would be practically *nil*. Speaking of this latter condition, Mr. Stewart, whose paper has already been cited, says: "There is practically no expense for charging—the amount of coal used is just the same as before the battery was put on, and the

ammeter is not deflected when the battery is switched in or out—in fact, we cannot detect that the feeding of these cells has added anything to the load of the machine." C. F. Annet, Superintendent of Telegraphs of the Illinois Central Railroad Company, Chicago, in a paper read at the Montreal Convention, says: "The current absorbed by the charging batteries is not enough to materially affect the light given by the lamps, and as it is furnished by our own lighting plant the cost is hardly sufficient to justify the estimate." All companies, however, do not possess their own lighting plant from which to get cheap charging current. Taking as a basis the cost at which this current could be bought from regular electric lighting companies it is found that an amount of current equivalent to that furnished by a gravity cell during one year can be bought for 9 cents. If we add to this 2.5 cents for interest on equivalent accumulator cells and 2.5 cents for depreciation of such cell the approximate cost of maintaining equivalent accumulator cells is found, and is seen, under unfavorable conditions, to be only 14 cents a year as against $1.50 for the maintenance of gravity cells.

Regarding the floor space required by the two classes of cells, Mr. Annet describes the situation humorously by saying that "while the primary battery filled a long-felt want, it also filled a room that was required for office purposes." Mr. Stewart puts himself on record on this point also, as follows: "Prior to the installation of this plant (the accumulator plant then in use in the West Shore Railway telegraph office), we had two banks of main battery of the gravity type, one of 140 cells, another of 50 cells and one also of 48 cells, for locals. These batteries required a room 12 x 12 feet; our present main battery of 70 cells (chloride accumulators) is kept in a closet 5 feet long, 4 feet wide and 10 inches deep and located in the dynamo room." As bearing further on this, one has only to consider the relative volumes of gravity battery and storage battery

Fig. 1.

cells to be convinced as to the possibilities of economizing floor space with the latter. Thus the gravity cell used in fire-alarm work is 8 inches high and 8 inches diameter, equivalent to a volume of 400 cubic inches. The outside dimensions of the accumulator jars used to replace primary cells in fire-alarm systems are 2¼ x 4 x 4½ or 40½ cubic inches, or one tenth the volume of the gravity cells. Fig. 1 represents a storage-battery plant installed in the City Hall, Philadelphia, to operate a police-telegraph system. On the stand in front are seen the storage-battery cells. The large cells to the left are the gravity cells not then displaced in favor of the storage cells. If an ocular proof is not convincing one has only to turn to Mr. Finn's monograph. Herein it may be found that one "chloride" cell has replaced as many as 72 gravity cells. The outside dimensions of a 100 ampere-hour storage cell are 3½ x 9 x 10½ inches. Is further proof necessary?

The fourth point of comparison between primary and secondary batteries has reference to the performance of the cells. In this particular the superiority of the storage battery is no less marked than in the points already discussed. It is noticeable, in working with primary batteries, that any irregularity in one circuit will introduce irregularities into other circuits worked from the same battery. It is therefore not considered practicable to operate more than two, or at the most three, circuits from the same battery. The failure of the primary battery to maintain uniformity in working under such conditions is due to the small surface of the electrodes in each cell and the high resistance of the intervening electrolyte. These circumstances limit the output of each cell. In storage batteries the plates have a very large amount of active surface, and are placed so close together that the internal resistance of the cells is reduced to about .002 ohm, making possible a very large ampere-output, amounting, in the larger sizes of cells, to 500 amperes at normal rates. One of these cells could replace a thousand gravity cells without requiring more than $\frac{1}{1000}$ of the attention needed by the latter. This large ampere-capacity of accumulator cells makes possible the operation of any number of local circuits, from a single cell of sufficient capacity, without the irregularities of one circuit introducing irregularities into others. Further, with primary cells the internal resistance is constantly varying; hence, since the resistance of the circuit is approximately constant, the voltage and the amperage of the cell will also vary. With storage batteries the internal resistance is practically constant; the voltage and amperage of these cells will therefore remain constant—an important desideratum in telegraph work. Again, with primary batteries trouble is constantly caused by the evaporation of the electrolyte and by creeping salts. With storage batteries these troubles are not experienced, principally because evaporation is reduced to a minimum; and as there are no salts in the electrolyte, "creeping salts" are unknown. Lastly, for all the reasons mentioned above, primary batteries require considerable attention, and even then their service is, to say the least, frequently trying. With storage batteries the only attention required is to see that the battery gets its proper charge and that the electrolyte lost through evaporation and other causes is replaced about monthly.

(To be continued.)

Experimental Tests on the Influence of the Shape of the Applied Potential Difference Wave on the Iron Losses of Transformers.*

BY STANLEY BEETON, C. PERCY TAYLOR and JAMES MARK BARR.

At the conclusion of some articles on "Wave-Form Synthesis," which were published in June, 1895,[1] we mentioned that we were then engaged in testing the iron losses in transformers with the aid

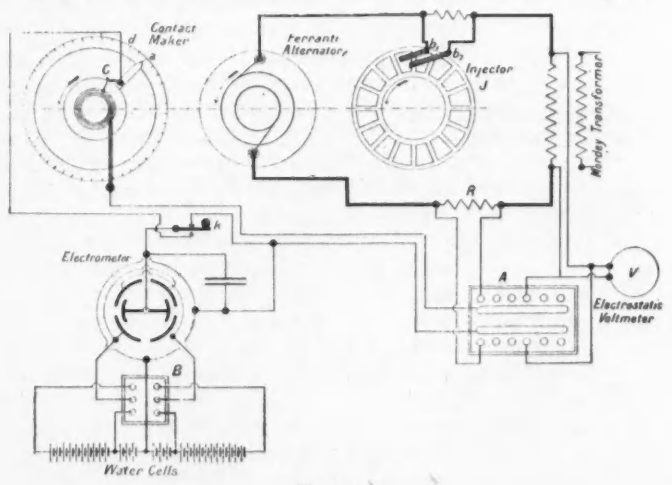


Fig. 1.

of the method we had devised for easily altering the shape of the applied potential difference wave.

This question of iron losses has naturally been regarded as one of

* Paper read before the Institution of Electrical Engineers.

1 *The Electrician*, June 21 and 28, 1895, vol. xxxv., pp. 257 and 286.

considerable importance by electrical engineers, since the success of every system of alternate-current supply depends to a great extent on the all-day efficiency of transformers. Hence we have thought that an account of some fairly complete experiments on this subject might be worthy of the consideration of this Institution. These

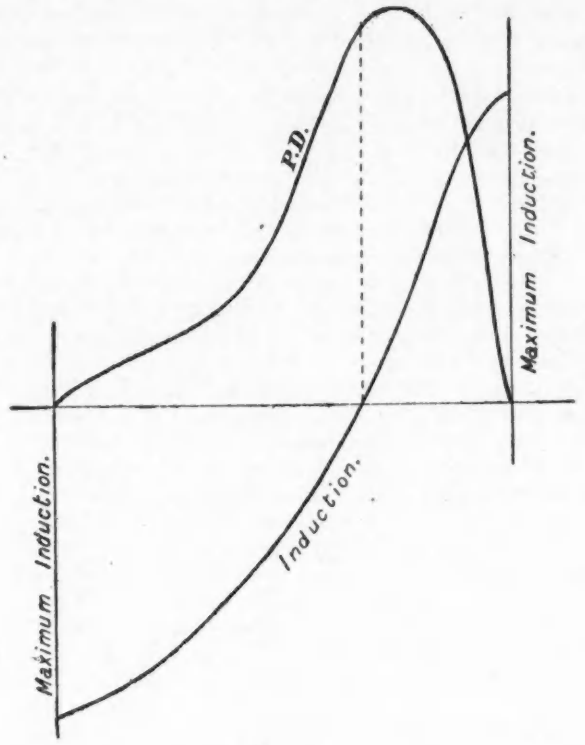


FIG. 2.

experiments were carried out at the Central Technical College, during May, June, and July, 1895.

WORK OF PREVIOUS INVESTIGATORS.

Up to August, 1895, when our investigations were completed, the most important contributions to the study of the effect of the shape of the alternating wave on the amount of iron loss in a transformer were the experimental tests of Dr. Fleming[2] and Mr. Steinmetz[3]; while the theoretical side of the question had been studied by Mr. Evershed[4] in 1891, and again more recently by Mr. Feldmann.[5]

Mr. Steinmetz carried out some tests in America in 1891, with a view to finding "whether there was any difference in the action of

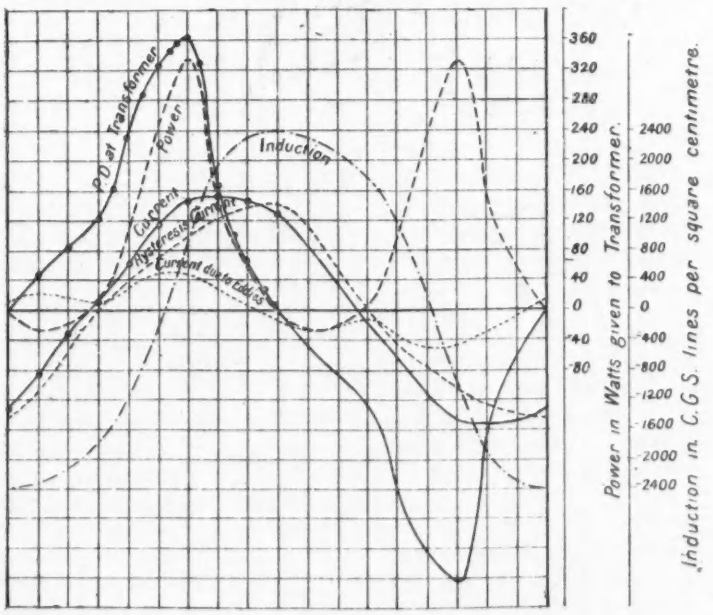


FIG. 3 B.

transformers" when worked off alternators of the iron-clad and smooth-core types An average difference of 9 per cent. in favor of the distorted iron-clad wave was observed; but it should be noticed in these experiments the power lost in hysteresis was alone considered, whereas the total loss in the iron must decide the question as to which of the two machines it would be better to employ. To make Mr. Steinmetz's tests, then, of any real practical value it becomes necessary to assume that the power wasted in eddy-currents does not vary with the form of the E. M. F. wave. And although we now think that this assumption is justifiable (as will be shown later), we do not consider that there was sufficient experimental evidence at that time to entitle Mr. Steinmetz to make this assumption. (It is possible that Mr. Steinmetz may have meant total iron loss when he spoke of hysteresis, but we cannot form any definite opinion on the point from the data given in his letter.)

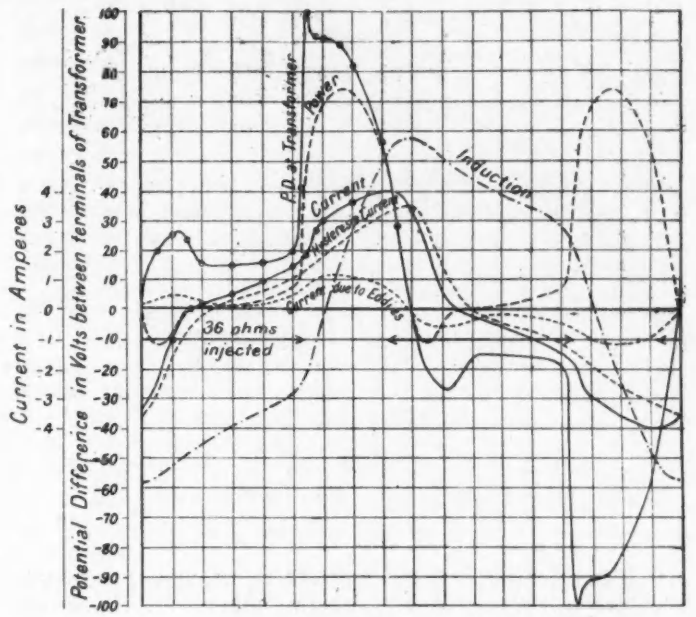


FIG. 3 A.

Dr. Fleming, who found "differences of 10 per cent. and 15 per cent. in the iron core losses," observed that "the iron core loss in any transformer was greatest on that alternator the E. M. F. curve of which most closely approximated to a sine curve" For his tests Dr. Fleming employed several different types of alternators, and this necessarily limited the number of types of E M. F. waves at his disposal. We think it was this limitation that led Dr. Fleming to the result stated above, for our tests certainly point to a conclusion which differs very materially from this.[6]

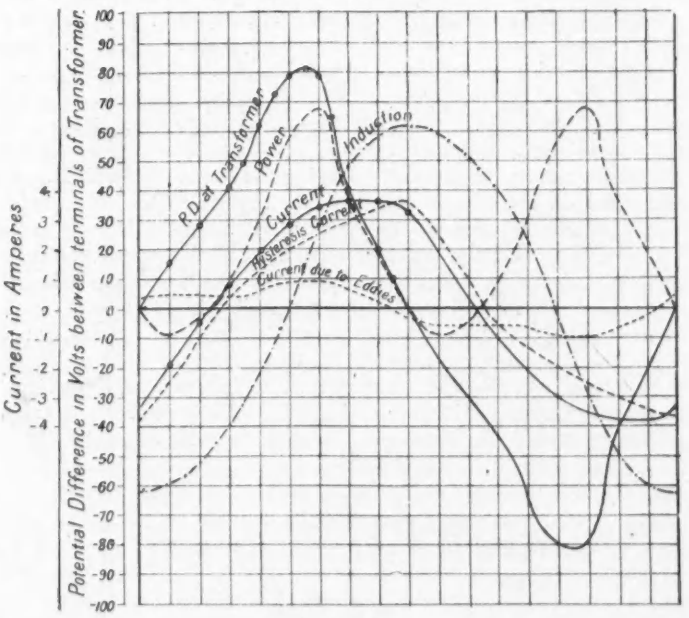


FIG. 3 C.

In a series of articles on transformers in *The Electrician* in 1891 Mr. Evershed dealt pretty fully with the question of the applied P. D. waves and the corresponding iron losses in transformers, chiefly, though, from a theoretical standpoint. He sums up this part

[2] *The Electrician*, June 28, 1895, vol. xxxv., p. 304.
[3] *Ibid.*, Aug. 24, 1894, vol. xxxiii., p. 498.
[4] *Ibid.*, March 27, 1891. vol. xxvi., p. 635.
[5] *Ibid.*, Oct. 18, 1895, vol. xxxv., p. 809.

[6] Since writing this we gather, from an article which appeared in *The Electrician* for Jan. 10, that Dr. Fleming has altered his opinion considerably.

of his subject by saying: "The broad lesson to be learnt from the diagrams is, that in studying iron losses in the cores of the transformers we may neglect the slight differences due to widely differing E. M. F. waves." Mr. Eversbed has given, in vindication of this statement, three waves, viz., the sine, the rectangular and the zig-zag, which, though they differ considerably in *shape*, do not, for the same effective value, vary much in *area*. This, as we shall show

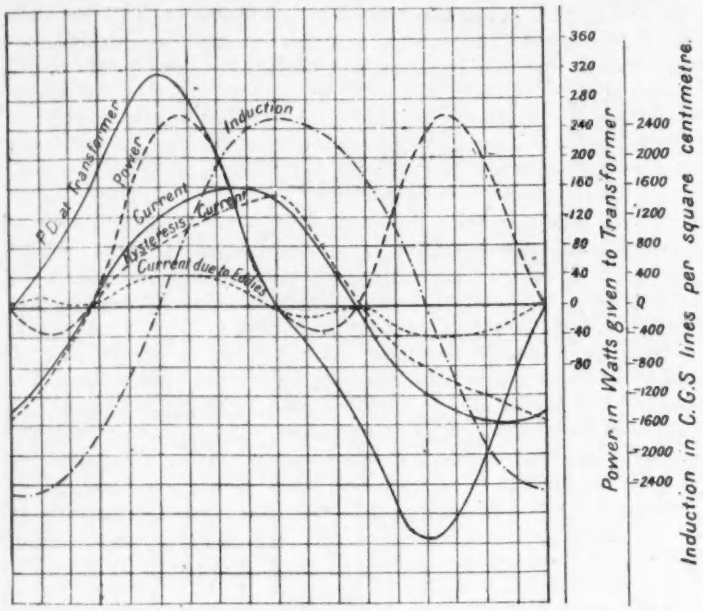


Fig. 3 D.

later, is an essential point. It is not, therefore, very surprising that Mr Eversbed did not discover a large variation in the iron loss when considering these wave-shapes.

We come now to one of the most recent contributions to this question, namely, that of Mr. C. P. Feldmann. This consists of an entirely theoretical treatment of the subject of this paper.

One or two serious errors have been pointed out by Mr. Hay,[7] and by one of the authors[8] of the present communication, in Mr. Feldmann's reasoning. But quite apart from these mistakes we do not think that the principle and methods of this paper, in which unnecessary complications are introduced, could ever be made of great practical value.[9]

DESCRIPTION OF APPARATUS.

The method employed in our transformer tests was that of obtaining the complete curves of potential difference and current by means of an electrometer and Joubert contact-maker. This method, while being simple and accurate, is absolutely complete; any results required can be calculated from the two curves taken. The P. D. was kept constant by means of an Ayrton and Mather electrostatic voltmeter; thus we used only electrostatic instruments which required no sort of correction, such as is necessary when wattmeters and dynamometers are employed.

The method we employed for varying the shape of the P. D. wave impressed on the transformer was, as already stated, the one described in *The Electrician* for June 28, 1895. It consisted in throwing into the circuit, during similar parts of each half wave, a resistance or capacity by means of an apparatus which we have called the "injector." It is indicated in the accompanying diagram (Fig. I.,) which also shows the details of the remainder of the apparatus used by us in testing the iron losses in the transformer.

The "Injector."—The arrangement which we have previously called the "injector" is shown diagrammatically at *J*. It consisted of two brushes, b_1 b_2, bearing on a commutator keyed to the shaft of the alternator. To these brushes was connected a resistance or capacity, as the case might be. We used a Ferranti alternator giving eight complete periods per revolution, and in order that we could throw into the circuit any desired resistance or capacity during certain similar parts of *each half wave* the commutator was made with 16 segments. These segments—completely insulated from the machine and from one another—had no connections brought to them whatever; they were merely used to periodically short-circuit the brushes b_1 b_2.

The position of the brush b_2 determined the *epoch*, or the instant at which the resistance or capacity was thrown into the circuit, while the distance between b_1 and b_2 determined the *interval*, or the duration of the effect for any given speed of the alternator.

To the other end of the alternator shaft was fixed the usual form of Joubert rotating contact-maker. The movable brush, *C*, and fixed graduated scale, used for taking the wave-forms, were also employed by us to fix the positions of the "injector" brushes in the following manner:

Method of Setting the Injector Brushes.—The normal P. D. wave was first obtained in the ordinary manner, and by this means we really calibrated the fixed scale of the contact-maker; that is to say, we found positions of the brush *C* corresponding with certain points in the wave of P. D., thus imparting a definite meaning to each point in the scale. Having decided over which part of the normal P. D. wave the injection was to take place, we found the points corresponding with this interval on the fixed scale of the contact-maker.

Let these points be *a* and *d*. The brush *C* was fixed with the pointer at *a*, and the alternator shaft turned until the metal web of the contact disc came under the brush (this is the position indicated in Fig. 1), and the trailing injector brush, b_2, was then adjusted till it was about to leave one of the segments. We next moved on the brush *C* to the point *d*, and turned the shaft of the dynamo until contact between the brush and the metal web was again restored. With the armature in this position the brush *b* was set so that it was just coming on to the next segment behind the one which b_2 had been adjusted to leave. It is evident, therefore, that during the interval in which the armature moves from the position *a* to the position *d*, the resistance or capacity inserted between *b* and b_2 would be in the circuit, and that during the remainder of the half-wave it would be short-circuited.

Transformer Details.—Our tests were carried out on a Mordey transformer designed for an output of three kilowatts. The transformer was wound with three coils, two consisting each of 12 turns, and intended to be used with a pressure of 50 volts, while the third, or fine-wire coil, was wound for a pressure of 2000 volts. This latter and one of the former were left on open circuit throughout these experiments, and the other coil was used by us as the magnetizing coil, taking about three amperes at a frequency of 100 ∽. Hence, as the resistance of this coil was only 0.016 ohm, the drop in pressure due to it was negligible.

Electrometer Connections.—The instrument used for taking our waves was an Ayrton and Mather quarter-cylinder reflecting electrometer, connected up in series with the Joubert contact-maker as

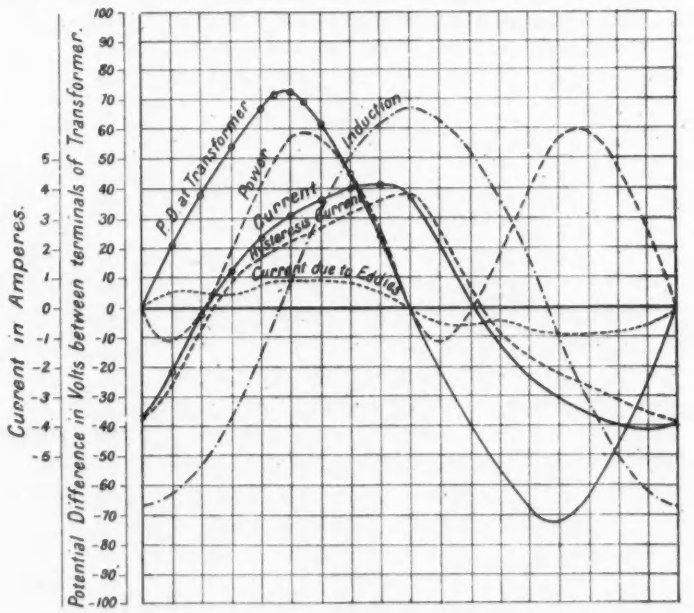


Fig. 4 E.

shown in Fig. 1. In parallel with the electrometer we had a small condenser, which was short-circuited by the key *K*, after every reading.

A number of water cells (connected with the instrument as shown in Fig. 1), were used to maintain a permanent P. D. between the opposite pairs of quarter-cylinders, and the P. D. to be measured was set up between the needle and the case. This method, as explained in our above-mentioned article, has the advantage of making the deflection directly proportional to the P. D. to be measured,

[7] *The Electrician*, Oct. 25, 1895, vol xxxv., p. 857.

[8] *Ibid*, Nov. 8, 1896, vol. xxxvi., p. 61.

[9] The only complete account of an investigation on the subject of this paper—published, however, since Aug. 1895, when our investigations were completed—is that by Dr. Roessler. This is dealt with at the end of this communication.

even when the auxiliary P. D. required in the heterostatic use of an electrometer is quite small.

The only readings used in working out the tests were those taken with the electrometer; for this instrument was also employed to measure the P. D. between the ends of a non-inductive resistance, *R*, placed in series with the transformer, and so to indirectly measure the current flowing through the latter.

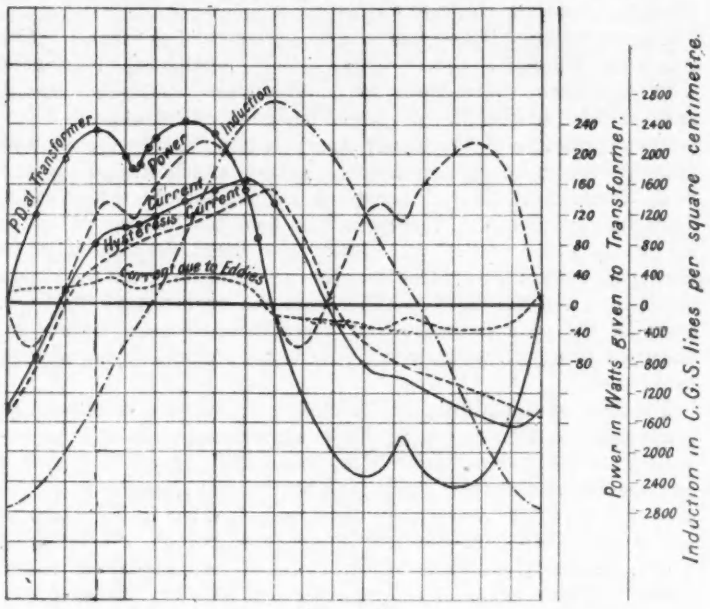


FIG. 4 F.

The electrometer was calibrated before—and in almost all cases after—every test with a set of 70 standard Clark cells.

In order to facilitate taking the instantaneous values of both P. D. and current in quick succession, two change-over switches were used at *A* and *B*.

A consisted of a solid block of paraffin wax, in which were cut two long slots and two rows of small holes, all of which were filled with mercury.

The electrometer and contact-maker were directly connected with the two slots, while to the small holes were led wires from the terminals of the transformer and the non-inductive resistance *R*, or from any points in the circuit between which we wished to find the instantaneous value of P. D. As a matter of fact, the terminals of the "injector" were also connected with a pair of holes in the change-over switch *A*; but these wires are not shown in the diagram, as the graph obtainable at these points was not always taken, and it did not form an essential part of the transformer test.

The value of the non-inductive resistance was 4.15 ohms, so that the maximum reading for obtaining the current-wave was about 16 volts, whereas the maximum ordinate of some of our P.D. curves was as high as 100 volts In order, therefore, to use the full range of the electrometer in each case, it was necessary to change the potential to which the quarter-cylinders were charged; hence for the P. D. wave we used six cells between the opposite pairs of quarter-cylinders, and for the current-wave 30 cells, the middle of either set being connected with the case as indicated in Fig. 1. This alteration was effected by means of the change-over switch *B*.

An Ayrton and Mather electrostatic voltmeter, *V*, was used to keep the R.M.S. volts at the terminals of the transformer constant during each test.

Speed of the Alternator.—The speed of the alternator, which could be adjusted by means of coned pulleys, was kept constant at 750 revolutions per minute, thus giving a frequency of 100 ∽. No electrometer reading was taken unless the speed, as shown by a Rungs pneumatic speed indicator, was exactly right. The indicator was checked several times by a revolution counter, and found perfectly accurate.

Advantages of Open Secondary Tests.—Since it is now generally admitted that, with the exception of a slight drop due to leakage at high loads, the total iron losses in a transformer are constant at all loads for the same frequency, we made all our tests with open secondary circuit.

This method of attacking the subject offers great advantages, because errors caused by the variations of temperature in the iron core and the non-inductive resistance *R*, due to the use of different currents, are not introduced into our experiments. In addition to this, it will be seen that the working out of our results is somewhat simplified, especially with respect to the determination of the maximum induction. It is in the determination of the iron loss, however, that the method possesses its chief advantages, for we can measure this loss directly, and not as the difference of two much larger quantities. By this means we have been able to find the iron loss accurately to within ½ per cent., which would have been quite impossible with a load on the secondary.

(To be continued.)

A Self-Cooling Condenser.*

BY LOUIS R. ALBERGER.

The author states that the object of the paper is to present a practical condensing apparatus for use with steam engines, and one that, while operating without a natural water supply, gives results that compare most favorably with those obtained in the ordinary manner. Because the circulating water employed to produce the condensation of the steam is cooled by the apparatus for re-use in itself, it is called a self-cooling condenser. It depends, however, for its effectiveness upon the capacity of atmospheric air to carry off heat and moisture when brought into intimate contact with heated water.

Broadly considered, the air becomes the condensing medium in the place of cold water as ordinarily employed, and, on account of its general distribution, the process can be performed at any place that may be desired. The adoption of this machine gives to all users of steam power a means of economy heretofore commercially unavailble, except to those whose engines are in close proximity to an abundant natural water supply. Non-condensing engines, in any locality, can be run condensing, with all the benefits that accrue, by the use of a vacuum. In the installation of new steam power plants, the highest types and most modern practice of compound and triple-expansion condensing engines can be used, without reference to the quantity of water available, except to provide a sufficient amount for boiler feeding purposes.

The author states that the idea of cooling the discharge water from the air pumps and re-using it in the condenser is an old one, that just such methods as are more commonly employed, while interesting, and in a limited way operative, would be inapplicable to the large majority of the steam plants of considerable capacity with which we are familiar, and which have become so necessary for modern mill, electric light, and railway purposes during the past few years.

An apparatus that can be safely employed as a reliable portion of a steam-power plant, must be simple and compact in construction, thoroughly durable, and so completely under control as to be practically independent of changes of wind and weather. These features are to be found in the self-cooling condenser as illustrated in section in Fig. 1. It consists of two parts: the condenser, in which the exhaust steam of the main engine or engines is condensed, and the tower, in which the heated discharge from the condenser is cooled to a proper temperature to be used again for the further condensation of exhaust steam. The tower consists of a cylindrical steel shell open at the top, supported upon a suitable foundation, and having fitted at one side a fan, the function of which is to circulate a current of air through the tower and its filling. This filling consists of layers of cylindrical tubular tiling, which rest upon a grating supported by a brick wall extending around the circumference of the tower. The heated discharge water from the condenser enters the tower at the side, passes up the central pipe, is delivered on the upper layer of tiling and over the whole cross-section of the tower by a distributing device, consisting of four pipes, which are caused to rotate about the central water pipe by the simple reaction of the jets of heated water issuing from one side of each pipe, after the manner of a Barker's mill. The water thus delivered spreads over the outside and inside surfaces of the walls of the tiling, and forms a continuous sheet, which is presented to the action of the air. The tiling, which are preferably 6 inches in diameter and 24 inches long, are placed on end in horizontal layers, one upon the other, and packed as closely as possible, the walls of each individual tile of each successive layer being disposed so as to come opposite the air spaces of the next lower layer, breaking joints, as it were.

Fig. 2 shows the arrangement of a portion of the tiling, the object being in this disposition to break up both the currents of air and water so that the most thorough and extended contact will take place. If there are 10 layers of tiling in a tower, then there are nine places, in addition to the original spreading at the top, at which there is a complete redistribution of the water. It will be seen that each tile

* Abstract of a paper presented at the May meeting of the American Society of Mechanical Engineers.

must rest on at least two, and possibly three, in the next lower layer. Assuming, however, that each tile rests on only two others, a given quantity of water, placed on any one tile in the top layer, will be divided over at least two tiles in the second layer, three in the third, four in the fourth, and so on, until it becomes spread over 54 in the lower layer on the grating. The practical importance of this extremely effective distribution of the water, due to the

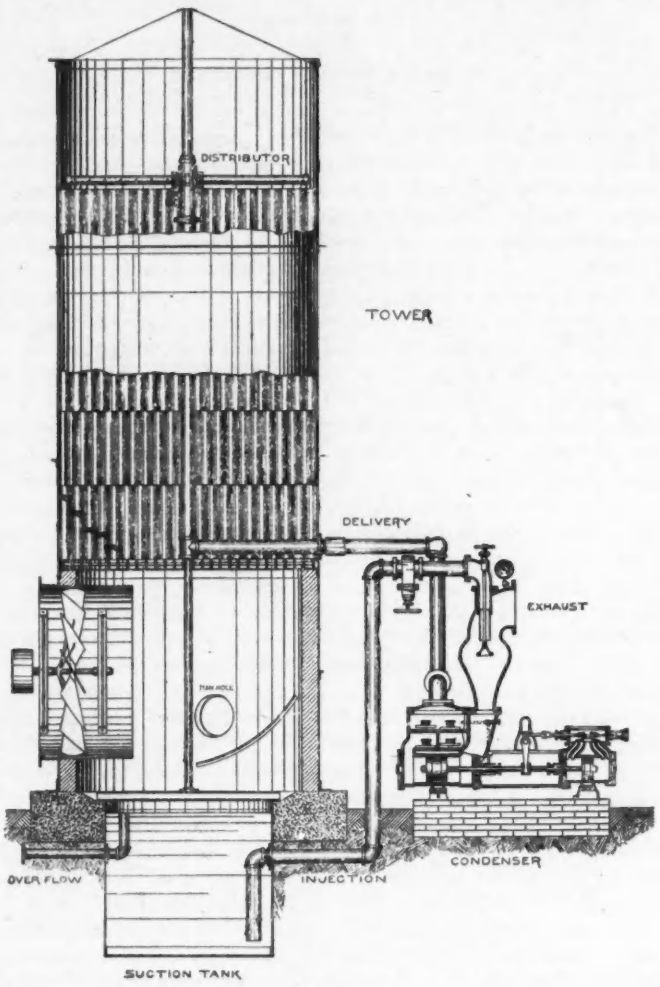


Fig. 1.

mere arrangement of the tiling, has been demonstrated in a tower where the distributor was purposely stopped, when the efficiency of the apparatus was found to be so slightly impaired that the difference was not noticeable in the engine room. The air is distributed in an equally good manner, and there is a large free area with equal facility for its passage upward over the entire cross-section of the tower. The heated water falling through the tower is cooled by three processes; first, radiation from the sides of the tower; second, the contact of cool air, and third, evaporation. This latter is by far the most important, as the evaporation of a pound of water in this way carries off about 1000 units of heat, and enables a pound of steam to be condensed in the condenser. As quite a proportion of the cooling is done by the first two processes, the evaporation of water in the tower must be less than the water formed by steam condensed in the condenser. Consequently, the supply of circulating water is constantly augmented and requires no replenishing. The cooled water falls from the grating to the subsiding tank at the bottom, and is from there drawn by the condenser to again perform condensation.

The condensing chamber in which the exhaust steam is brought into contact with the water is shaped so as to conserve the velocity of the incoming water, increased by the impact of the exhaust steam at the point of condensation. The injection water and the water resulting from the condensation of the steam pass unobstructedly to the pump, and by their momenta assist the pump very materially. The air and uncondensable vapors are thoroughly intermixed with the water, and are not at any time allowed to separate from it. The pump has a duplex valve motion, and gives a regular and constant flow of the mixture, which is more nearly aerated water, and is widely distinguished from the air and water in comparatively large and separated volumes as they are found in ordinary air pumps and condensers. The effect of this intimate and complete mixture is two-fold; the pump is largely assisted in its work, as shown by the fact that there is a lesser degree of vacuum in the pump cylinders than obtains in the condensing chamber, and the action of the pump is steady, as it moves in a constant stream a fluid of practically uniform density. For this latter reason the pump is capable of elevating the water to the top of the tower with ease and regularity. A single pump thus performs the double function of maintaining the vacuum and of supplying the heated water to the tower, reducing the apparatus to its simplest form.

The operation of the system may be summarized as follows: The cool water drawn into the condenser from the suction tank is mingled with the exhaust steam from the main engines, and being heated and increased in quantity by the condensation of the latter, is delivered by the pump to the tower, where it is cooled by the air and falls into the subsiding or suction tank, from which it again passes to the condenser. There is constantly coming into the system water from the city mains or other source to feed the boilers. There is constantly going out of the system the water evaporated in the tower, an amount that is less than that which comes from the steam condensed, and the slight overflow from the suction tank that will carry off the oil and grease that come from the engine with the exhaust steam, and which would tend to accumulate in the suction tank.

The floor space occupied by the cooling tower of this self-cooling condenser is not excessive, as will be appreciated when it is understood that an apparatus suitable for 1000 horse-power is only 17 feet in diameter and 30 feet high. The suction tank, which is placed directly under the tower and in the foundation, is 8 feet in diameter and 7 feet deep, and contains about 2000 gallons of circulating water, this being a sufficient quantity to fill the condenser pump, pipes, and tower on starting up, and to carry on continuously the transfer of heat from the exhaust steam to the atmospheric air. The location of the tower may be on the engine room floor, on the top of the building, or in the yard, the latter place being well adapted.

The fan for the circulation of the air requires but very little power

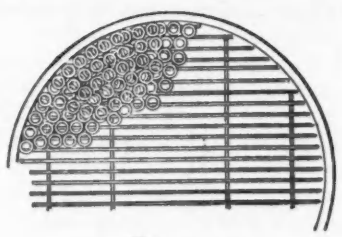


Fig. 2.

for its operation, and careful tests have shown it to be less than 2 per cent. of the power of the main engine during the maximum requirements of Summer, while the average for the year in this climate will not exceed 1¼ per cent. The fan may be driven by an electric motor, belting from the main shafting, or by a small steam engine, as the conditions of the situation may render most desirable. The latter method is usually preferable, as the speed can be more easily regulated to suit the requirements.

The relative amount of moisture in the air, of course, affects its cooling value, especially in Summer, when the evaporation in the tower is the process principally relied upon to carry off the heat.

The tower of the Edison Electric Illuminating Company of Brooklyn, installed by Henry R. Worthington, is placed in the yard at the rear of the station, and at a distance of about 60 feet from the condenser. It has run continuously since March, 1895, in connection with three Ball cross-compound engines of 250 horse-power each. Through the heated term of last Summer 24 to 25 inches of vacuum was readily maintained. The appearance and operation of the condenser in the engine room are exactly as if a large natural water supply was being employed for the condensation. The circulating fan in the tower is operated by an electric motor, and after it is started requires no further attention from the engineer in charge.

In the application of this system to a plant in which the engines are run non-condensing, no change is made in the method of feed-water supply as there employed. The feed pump and the ordinary main exhaust heater are left in position, and the exhaust steam from the main engine is passed through the latter on the way to the condenser. The steam exhausted by the condenser pump, boiler-feed pump, and the small engine which runs the fan (if a separate engine be used), is conveyed to a separate heater of moderate size. This supplementary heater receives the feed water, which already has been heated nearly to the temperature of the exhaust steam, say to 110

degrees Fahr., with a vacuum of 26 inches, by the main heater between the engine and the condenser. The exhaust from the auxiliaries being entirely condensed in the supplementary heater, its heat is transferred to the feed water and by this means returned to the boiler. The temperature of the feed water will approximate that obtained when the same plant is run non-condensing, and varies, according to the conditions, from 170 degrees to 200 degrees Fahr. It is evident that as that portion of the heat in the steam supplied to the auxiliaries, and not converted into useful work nor lost by radiation, is completely returned to the boilers, the efficiency of these machines is very high. They approach, in fact, what may be called *perfect steam engines*, for an engine that returns to the boiler the heat that is not converted into useful work may certainly be said to be a perfect one. For a careful exposition of the economy to be reached in the operation of the auxiliaries by utilizing the heat of the exhaust steam, reference is made to a paper by Otto

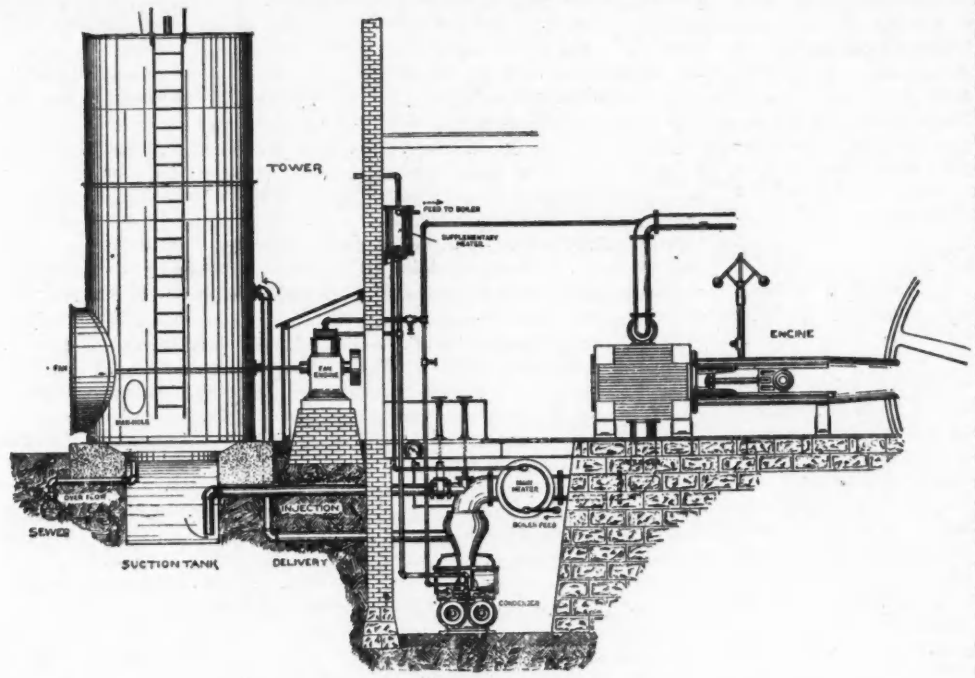


FIG. 3.

H. Mueller, C. E., read before the Hungarian Architects' and Engineers' Society of Budapest, and published in *Engineering*, Nov. 10, 1893.

Fig. 3 shows a complete self-cooling condenser system as applied to a Corliss engine, and indicates the positions of the main and supplementary heaters with the pipes and connections. The condenser is shown in the basement, but it can just as well be on the level of the engine room floor, if the proper arrangement of exhaust piping is made to prevent accumulation of drip water in the horizontal length.

Regarding the total cost of producing vacuum by this system it can be said that, while the cost varies according to the size of the plant and different operating conditions, it may safely be taken as within an average of 5 per cent. of the power of the main engines when the latter develop a horse-power within 20 or less pounds of water per hour.

It may be well to mention a feature of superiority of the self-cooling condenser over a condenser dependent upon a natural water supply such as is usually to be had, especially when used in connection with steam engines subject to great variations of load, as are found in electric railway, rolling mill and similar irregular work. It is substantially correct to say that not less than half of the condensing apparatus in use in connection with stationary engines are located so as to be compelled to lift the injection water at least 16 feet, and a number as high as 20 to 22 feet. This is caused by the fact that the stations or mills, if they are alongside of a river, are usually placed upon moderately high and firm ground. The result of this arrangement is that, in case of a sudden overload of the engine by which steam may be carried three fourths of the stroke instead of one fourth of the stroke as normally, the condenser is not capable of maintaining the full degree of vacuum, and when the vacuum falls, as it must necessarily, unless a very large and extravagant amount of water is being passed through the condenser, to a point below that due to the suction lift plus the friction in the pipe, say to 20 inches, then the water is lost entirely, and the engine must either be run non-condensing or the condenser cooled off and started by means of a forced injection from some outside source. This is a very undesirable occurrence in an electric railway station, as can be readily understood. With the self-cooling condenser, however, having the suction lift reduced to a few feet, and a supply of water on hand entirely free from debris or foreign material such as would cause the stoppage of the injection supply, an overload may come to the condenser and the vacuum temporarily fall to a point as low as 10 inches without becoming entirely lost. Just as soon as the cut-off again takes place at an earlier point, the vacuum will return to the normal degree without the extreme annoyance of shutting down or of cooling and priming the condenser.

Many of the plants erected during the early history of electric lighting were located without the advice of qualified steam engineers, or the benefit of advanced practice. The question of the economical production of power was lost sight of in the strife to be the first in the field with the electric light. Furthermore, it was expected by some that electricity would be so cheap as to render it unnecessary that the cost of its production be taken into consideration. This, however, has now assumed quite a different aspect, and the power plant is conceded to be the main feature in the success or failure of an electric lighting or power venture.

Those companies with generating plants away from a natural water supply, such as a river or a canal, are severely handicapped in the matter of cost of power by competitors who have been more fortunate in the locations selected, and who, by means of condensation, are able to produce power at very much less expense. On the other hand, it may be said that sites along water fronts in large cities are expensive, and are often at a long distance from the centre of distribution of the electric current, making necessary the use of lengthy and costly conductors to transmit the current. By the use of the self-cooling condenser, the advantages of condensation can be added to those of central and already determined locations, and the plant placed nearly, if not fully, on a par with the best and most recent practice of condensing engines with natural water privileges.

A Curious Röntgen-Ray Effect.

To the Editor of The Electrical World:

SIR:—In Mr. F. C. K. Laflamme's letter, which appeared in THE ELECTRICAL WORLD, May 16, he shows two Röntgen-ray photographs of the foot, and calls attention to collections of peculiar white spots on the print.

Let me suggest, as an explanation, that these spots are the effect of minute electric discharges; for, upon careful examination of the cut they will be found to have small radiating branches of the characteristic discharge shape. It will be noted that Mr. Laflamme had metal behind the photographic plate. It would then seem that the person whose feet were photographed received, directly or by induction, sufficient potential for a discharge to take place from the moist part of the foot, nearest to the photographic plate, to the metal on the other side, and that the so-called dielectric resistance of the photographic plate was reduced sufficiently by the conducting action of the rays to allow this discharge to take place, assuming the conditions to be otherwise right.

F. H. LORING.

NEW ROCHELLE, N. Y.

A Method of Obtaining Good Röntgen Radiographs.

To the Editor of The Electrical World:

SIR:—I have found that the use of a diaphragm greatly improves the outline and definition of Röntgen-ray pictures. The one which I have used consisted of a sheet of lead 4 millimetres thick and 14.5 centimetres square, with a circular aperture 3 centimetres in diameter at the centre.

The diaphragm was placed 1 centimetre distant from the tube.

VALPARAISO, IND. JOSEPH F. SMITH.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Dynamos with Concentric Helices. BERTHIER. *L'Eclairage Elec.*, May 9; a conclusion of his article (see *Digest*, May 23).—He gives illustrated descriptions of various forms of these machines, the general principle of which is that a continuous circular coil like a Gramme ring is moved through one or more similar stationary coils; various means for moving the inner one are shown; among the advantages claimed for this new kind of machine are: the lines of force are not deformed on account of their short length; the hysteresis is diminished considerably; the largest possible amount of wire is made active; the magnetic field is perfectly symmetrical; the armature may be wound with the same mass of wire as the magnets and the utilization of the wire is therefore a maximum; commutators are used as usual; such a machine also forms an excellent transformer for continuous currents and he suggests that it may be used for running a 10 or 15 volt lamp with a single battery having large electrodes.

Synchronous Motors. OSSANNA. *Elek. Zeit.*, May 14 and 21.—A mathematical article in which he investigates the effect of the self-induction and the armature reaction on the upper limit of the stability of a transmission; he also gives briefly a graphical and analytical discussion of the theory of such motors.

Paralleling Alternators Four Miles Apart. Elec. Eng., May 27.—A brief account of what is said to be the first instance of paralleling two alternators at a great distance from each other; this is done at Seneca Falls, N. Y.; two General Electric generators of 100-kw composite-wound 2300 volts and 60 cycles, are located about four miles apart, one of them being operated by water-power only, lights and power being supplied at both ends; in order to fully utilize the water-power one of these is being run continuously at full load, while the distant one is generating only the additional amount required; the regulation is done at the end at which water-power is used; "by carrying a strong field on the Seneca Falls machine the drop of potential due to line induction is entirely eliminated"; the working of the system has been very satisfactory, the increased economy being quite noticeable.

LIGHTS AND LIGHTING.

Alternating Arcs and Wave Forms. STEINMETZ. Lond. *Elec.*, May 22.—A brief communication replying to the editorial in that journal on Mr. Frith's recent paper (see *Digest*, May 23). He calls attention to a paper read before the American Institute of Electrical Engineers in 1890 by Tobey and Walbridge and concludes that "it cannot be said that the alternating arc modified the wave shape so as to be the best suitable, but rather that it introduces a discrepancy between the current wave and E. M. F. wave, resembling a very high apparent resistance of the arc at or near the zero value of current, and a low apparent resistance during high values of current and thereby tending to distort the E. M. F. wave toward double peakedness and flat top, or the current wave toward single peakedness and flat zero, the former distortion being predominant in generator circuits of high internal reaction, the latter in circuits of low internal reaction."

Incandescent Lamp Filaments. DELAHAYE. *L'Eclairage Elec.*, No. 6; abstracted in the *Jour. Inst. Elec. Eng.*, May.—He gives a summary of the different researches made recently to obtain in such lamps the brilliancy imparted by the rare oxides which are used in the incandescent gas mantels; most of the results were unsuccessful; carbide of calcium gave very encouraging results, the light being more brilliant and agreeable; the lamps are strong and have a more regular resistance; the surface is only two thirds that of pure carbon and the filaments are as hard as diamonds; to compete satisfactorily with incandescent gas lighting, it is claimed it will be necessary to increase the efficiency of the electric lamps to 2.5 watts and even 2 watts per candle, which result does not appear near at hand; in an electric lamp one candle-power is emitted for every 2 to 6 sq. mm whereas in the Welsbach mantel it requires 33 sq. mm.

Edison X-Ray Light. Elec. Rev., June 3.—A brief report of a recent interview in which Mr. Edison stated that a photograph (reproduced in the *Elec. Eng.*, June 3) had been taken by this light with an exposure of 30 seconds; his tests indicate that about 1200 of the one-cp. lights can be obtained per horse-power; he does not venture to say how successful this light may become as a commercial light, the chief difficulty being in making the apparatus practicable; the lamp takes a current of two amperes and 0.3 volt in the primary, the current being interrupted 250 times per second; the average spectrum shows a lower refrangibility than the arc or the Welsbach light; a globe six inches in diameter will give about eight candles; the best commercial lamp (presumably meaning the incandescent electric lamp) requires 3.5 times the amount of energy per second taken by this lamp.

Edison's New Light. El'ty, June 3.—A report of an interview covering partly the same ground as the abstract above. The light differs in appearance from Moore's light, in that it seems denser, more tangible and more brilliant; the spectrum was normal, with plenty of red in it, but too much of the violet to correspond with the sunlight; there seems to be some difficulty in preventing the deterioration of the vacuum; the six-inch bulb gave about two candle-power.

Tesla's Vacuum Lamp. Elec. Eng., May 27.—A brief, illustrated (but very unsatisfactory) description of this lamp, taken from a daily paper; it contains but little or no technical information; he is said to have stated that he can deliver 10 per cent. of the initial energy in a pure, white light, which is said to be three times the efficiency of an ordinary incandescent lamp; the lamp contains no filament and is said to be very highly exhausted; a lamp of the same size as a 16-cp incandescent lamp is said to generate 250 candles.

Spectroscopic Examination of Moore's and Edison's New Lights. PERRY. *El'ty*, June 3.—A brief description of a personal examination. The spectra of the Moore tubes appear to be continuous, but the colors were separated by strong lines of demarcation, although there was no discontinuity, the spectrum being of a banded structure; in the white tube the red was very deficient, but in the red tube it is in excess of that found in incandescent lamps; the violet is in excess; the spectrum of a white light cannot be said to resemble in any way the spectrum of daylight as claimed, the colors are all there, but in different proportions; he suggests, after quoting from other authorities, that the spectrum is simply that of rarefied nitrogen, containing a little oxygen. The spectrum of the new Edison fluorescent light showed much more red than of the arc light and apparently not far from the same proportions found in sunlight, but the violet was in excess; the spectrum was like that of incandescent solids without flutings or bands.

Vacuum Tube Lights. WESSELS. *West. Elec.*, June 6, and *El. Age*, May 30.—A communication regarding the claims of Moore, Tesla and Edison, and pointing out what Moore has actually accomplished as distinguished from what the other two inventors claim that they are "going to do"; it includes a chronological record of Moore's work.

POWER AND HEAT.

Arc Welding. M'CARTHY. Lond. *Elec.* and *Eng'ing*, May 22.—A reprint with illustrations and the discussion of a recent paper on "Street Steam Pipes and Fittings and the Bernardos Arc Welding in Connection Therewith"; it refers to steel pipes in general and includes an illustrated description of the method of welding them. It has been found that longitudinal seams are best made in the usual way, although it can be done successfully by means of the arc, but there is no saving; the arc process is applied to the circumferential joints, as those made in attaching flames to the pipes; this process has been used for over five years at the Lloyd & Lloyd works; the process has been already described in various technical journals; ordinary lighting dynamos are used in connection with a battery of accumulators; one terminal is connected to a carbon pencil held by the workman and the other to the table on which the work rests or to the work itself; with iron and steel the carbon is usually made the negative pole, but for other metals the polarity is somewhat reversed; in an appendix the results of tests of the tensile strength of electrically welded bars of various kinds are given, as also a comparison with fire-heated bars. In welding a flange the flange itself is shrunk around the end of the pipe, leaving a V-shaped space between it and the pipe, into which small pieces of steel are placed and welded in one by one, the welds being freely hammered; it is also used for branches, T-pieces, etc.; the longer the arc the softer is the heat, and any slight strain which may be set up can be gotten rid of by careful annealing; a long arc is indispensable for the proper working; smaller flanges are welded on the tubes by spinning them in a lathe at a high speed and allowing the arc to play on them. Defects in steel castings and finished forgings are repaired with the greatest ease; a proof that the welding has been perfect is shown by the fact that the steel turnings taken from those places are sound and whole, showing that the metal has not been made brittle. From the tables in the appendixes it appears that the general average of the electrically heated welds is 18.5 per cent. better in figure of merit as

compared with the fire-heated welds; with iron the difference is slight, but with steel the fire-heated welds are more weak and uncertain. In the discussion Mr. Howell suggested that this was really electrical soldering and not welding and believes that the metal at the weld is more brittle; judging from experiments he did not think electric welding was as good as gas or roll welding. Mr. Carter did not think that it was merely a soldering process, as the current seems to carry the melted metal of one part into the metal of the other so that the two are interlapped and not merely stuck together.

Producer Gas-Engine Electric Plant. SNELL. Lond. *Elec.*, May 22.—A brief description of a plant at an iron foundry consisting of three engines of 120 horse-power; it was found that power is developed at the rate of one brake horse-power per pound of anthracite coal, and allowing for the loss in transmission, the power at the motor shafts corresponds to 1.25 pounds of anthracite coal per hp-hour.

Di-phase Transmission Plant. L'Energie Elec., May 1.—A long illustrated description of the 200-hp power and light plant at Decize in France erected by a French firm.

High-Tension Power Transmission. Elec. Eng., May 27.—A note stating that the Westinghouse Company is making experiments at Telluride with a transmission of about 100 horse-power over an ordinary iron telephone wire for about 2.5 miles at voltages up to 60,000, the wire costing only $35; it has been run at various voltages from 15,000 to 60,000, and during snowy weather at about 35,000.

New York-Niagara Power Transmission. Elec. Ry Gaz., May 25.—A note referring to the transmission of a small amount of power from Niagara to the exhibition in New York City; two-phase currents are transmitted over two wires, using the ground as a common return; the wires have a resistance of 3.3 ohms per mile, and the distance is 465 miles; the voltage at the Niagara end is 450; this will deliver a current of 0.146 ampere at 225 volts on either leg of the two-phase system, aggregating 65.7 watts, an amount of power which is thought to be enough to drive a light model.

Problems in Electric Elevator Work. COCHRANE. *West. Elec.*, May 30.—A reprint of a recent paper read before the Chicago Electric Association; it is accompanied by a large number of illustrations showing details; it is devoted chiefly to a review of some of the details of construction, showing that many engineering problems are involved in electric elevator service; the style of gearing almost invariably used for elevators and buildings is the worm and worm wheel, or some modification in which the winding drum is used.

Electric Elevators in an Elevated Railway Station. West. Elec., June 6.—A brief, illustrated description of the large passenger elevators used at one of the terminal stations of the Lake Street elevated railways in Chicago.

TRACTION.

Horseless Omnibuses. Lond. *Elec. Rev.*, May 22.—An editorial reference to the prospectus of a company to be formed to run the electric omnibuses in London; the itemized cost of operating over 900 omnibuses by horses for six months in London is given, covering a total mileage of over 10,000,000, and is found equal to 10.64 cents per omnibus per mile, exclusive of drivers, conductors, office expenses and general administration; the estimated cost of running these omnibuses electrically is also given, and is found to be 4.88 cents, exclusive of the same items. Editorially the opinion is expressed that there is little doubt that electric omnibuses will prove successful, but that something more is wanted than a trial of 5000 miles, which was the total distance covered by the experimental omnibus, on which these estimates are based. One of the features of the Ward system, which is the one under discussion, is said to be that the omnibus can be started or run up hill without an increase in the rate of discharge of the battery; it is suggested that more information on this point is desired; a doubt is expressed of the soundness of the estimates given.

Resistance Measurement of Rails. KALLMANN. *Elec. Zeit.*, May 21.—A communication referring to the test of West (see *Digest*, May 23) and those described in the *Digest*, March 28, to which are added the following suggestions to eliminate the unavoidable variations of the testing current: He suggests drawing two coupled cars by means of horses over the rails to be tested, while a current of 50 or 100 amperes passing through a constant resistance is sent through the rails; the voltage is then measured between the two moving cars.

Rouen. Lond. *Elec. Rev.*, May 22.—An illustrated description of this line from a critical and comparative standpoint.

Electricity on Steam Railroads. BAXTER. *Elec. Eng.*, May 27. A conclusion of his long serial (see *Digest*, May 30).—He completes the estimated cost of an electrical equipment for the Pennsylvania Railroad system; from four different estimates of power he finds that a total of about 148,000 horse-power would be required which should be increase by 25 per cent. to meet the increased traffic at certain seasons and another 25 for the heaviest demand during the day, thus making a total of about 231,000 as the amount of power delivered on the track; allowing an efficiency of 60 per cent. this would mean 385,000 horse-power for the steam engine capacity which corresponds to about 145 horse-power per mile. The stations should be as far apart as practicable; by using rotary transformers they can be placed 45 miles apart without an undue expenditure of copper, thus requiring 60 stations, each operating about 6 trains; the operating current would be at 700 volts; sub-stations operated at 5000 volts would be located 15 miles in each direction from a station; the capacity of each station would be 6500 horse-power with a maximum of 8000; the estimated cost of each station and sub-station is given, making a total for the 60 stations of $37,620,000; the 1000 motors would cost in addition about $6,000,000; this estimation is only a rough approximation. The cost of operating is also given, amounting to a total of $2,725,000; there would also be a net saving of more than 11 per cent. of the investment. If the claims made are well founded electricity will be cheaper and safer; railroad managers are trying branch roads in various places to convince themselves and when they have been so convinced he thinks the transformation will become even more rapid than was the case with street railways.

Nantasket Beach Road Eng. News, June 4.—Electric traction on this branch of the N. Y., N. H. & H. R. R., is to be extended by using a third rail instead of an overhead wire, as the conductor; this is for purposes of experiment to find the comparative merits of the two systems.

Conduit System in New York. Elec. Ry. Gaz., May 25.—An illustrated description of the Love system, a short experimental line of which is being operated on Amsterdam Avenue; the full pressure of 500 volts is used; several of the details are illustrated.

Bergen County System. Elec. Eng., June 3.—An illustrated description of the plant.

Budapest Underground Railway Car. Elec. Eng., May 27.—A reprint of the illustration mentioned in the *Digest*, May 30.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Use and Economies of Rectifiers for Arc Lighting. HESKETH. Lond. *Elec. Eng.*, May 22; an abstract of a recent paper.—Among all the existing systems of arc lighting, he states that there is scarcely one in which some glaring insufficiency does not appear; in the present paper he gives some recent detailed experiences with the use of rectifiers for this purpose at the Blackpool station, where Brush machines are also used. The apparent efficiency of the rectifier is of almost as much importance as its real efficiency, for if the power factor is low, the great current prevents the generating plant from being used at its highest capacity; a high power factor is opposed to a very high percentage of regulation; in the more recent types of rectifiers an apparent efficiency of 90 per cent. and a true efficiency of 95 per cent. is obtained with good regulation between one tenth and full load; for a modern steam alternator an efficiency, referring to the electrical and the indicated horse-power, of 85 per cent. is unusually high; referring to the energy in the lamps and the indicated horse-power, including the rectifier, the efficiency is 80.75 under the most unfavorable circumstances; a Brush 55-lighter set, under ordinary working conditions, has a mean efficiency of 47.37 per cent., as against 80.75 per cent. for the rectifier and alternator; with the larger-sized Brush machines used in America, the efficiency is as high as 75 per cent., but this is exceptional; the floor space of a direct-driven plant and a brush arc-light machine he shows to be 7 sq. ft. per kw., or for a rope driven plant 16 sq. ft., while for a rectifier plant including the alternator it is 2.3 sq. ft.; the efficiency should really be based on the energy added to the engines in the case of the rectifier plant, as the current is taken from the alternators. Regarding the effect of the rectified current on the lamps, he states that they have self-induction and produce effects intermediate between those observed with direct and alternating currents; the arc lamps therefore should have their series cores laminated and the bobbins split, but this is not necessary for the shunt coils; the pull of the core is rather less and more sluggish than with a continuous current. There is an undoubted influence of such currents on telephone circuits, when they are used in series, as is usually the case; the heavy sparking at the brushes of a rectifier is not as damaging as might be imagined, and with proper care the commutator will last quite as long on other types of arc lighting machine; the danger claimed for the use of a rectifier with such high-tension currents, does not show itself in practical use; as to the maintenance, he states that it is a matter of much greater ease and economy than of any other arc lighting plant in the station.

Gas Engine Sub-stations. Lond. *Elec.*, May 22.—An editorial note stating that the municipal authorities of Belfast had decided not to proceed with their original scheme of building a number of gas engine sub-stations, fed from the municipal gas works, but instead of this they are about to erect a large steam station. A few figures are given for the past experiences at this station, enabling a comparison to be made: a total of 95,000 kw-hours have been generated by fuel gas from the town mains at 46.8 cb. ft. per kw-hour generated; the price paid for the gas was 2.52 cts. per kw-hour; the energy lost in the accumulators was 6.7 per cent. of the total generated, and that lost in the mains was 2.3 per cent.; the consumption of fuel gas per kw-hour sold was therefore 53.7 cb. ft. at a cost of 2.90 cts. It is stated that the claim that such engines consumed much more lubricating oil is not correct, the cost of the oil being 0.464 ct. per kw-hour sold, which is lower than is often the case with the steam engines; the total generating expenses were 6.48 cts. per kw-hour sold; the generating plant cost $76.75 per kw, which is well be-

low the average, and tends to show that the capital cost of a gas-driven station need not exceed that of one of equal capacity run by steam.

Use of Accumulators with the Alternating-Current Supply at Zurich. *Jour. Inst. Elec. Eng.*, May.—A long abstract of the article noticed in the *Digest*, Feb. 29.

High-Voltage Lamps and Their Influence on Central-Station Practice. *Jour. Inst. Elec. Eng.*, May.—A reprint of the complete discussion of Addenbrooke's recent paper, abstracts of which have appeared in the *Digest*.

Charging for Electric Lighting Service. Farnsworth. *Elec. Eng.*, June 3.—He criticises the crude and inaccurate methods in general use, and gives an exposition of the fundamental principles of a proper system of charging, after which he describes one in which some of the defects of the others have been removed. All operating expenses may be divided into three classes, based on the manner in which they could be proportioned among the customers; the first class contains those items which should be shared equally by each customer irrespective of size, and includes such items as office expenses, meter readings, repairs, salaries and wages; the second class contains expenses which should be divided among the customers in proportion to the size of their equipment, and includes interest, depreciation, energy wasted in transformer cores, extra labor during heavy loads, etc.; the third class contains the remaining operating expenses, all of which are some function of the customer's consumption, and includes coal, oil, waste, ashes, loss in lines, machinery repairs, and all operating expenses which are a function of the load. He criticises the other methods of charging and then suggests a new one in which each consumer pays his proper share of each of the three classes of items in addition to a certain profit for the company; for each consumer the first and second class remain constant, thus forming a base rate to which is added the charge for current in the third item; the base rate is directly dependent on the number of consumers and it is therefore to the advantage of each to make this number as much as possible; the greater the amount of current, the less is the ratio of the base rate to the total charges and this he thinks tends to promote consumption; the items under the first two headings should be figured strictly at cost, the profit being made on the current only; a suggestion for the clauses of such a contract are given.

Alternating-Current Distribution System. *Elec. Eng.*, June 3.—An illustrated description of the Farraris and Arno system described in the *Digest*, June 6.

WIRES, WIRING AND CONDUITS.

High-Pressure Cable Coupling. Lond. *Elec.*, May 22.—A brief, illustrated description of the Penson cable; a sort of stuffing box with rubber washers is secured to the end of each cable, and these are then united by a screw coupling, the contact being made with a split plug forced into a hollow cylinder; it is applicable to concentric cables when somewhat modified.

Service Connection for High-Tension Currents. *Elek. Zeit.*, May 21.—A brief, illustrated description of the Probst connection box intended for high-tension underground circuits; it is a T-shaped box in which the circuits may be disconnected; it contains fuses.

ELECTRO-PHYSICS AND MAGNETISM.

Nature of X-Rays. Goldhammer. *Elek. Zeit.*, May 21.—An abstract of a paper read Feb. 8; he shows that the chief properties of X-rays could be explained on the assumption that they are ultra-violet light of extremely small wave length; the absence of regular reflection is explained by the unevenness of the polished surfaces, in proportion to which the wave lengths are too small; such surfaces can therefore not act as a polarizing apparatus for these rays; that the absorption of X-rays varies as the density is analogous to the property of aniline and similar solutions toward visible light, the absorption being proportional to the concentration; he thinks the molecules of the mass in the ether act on the X-rays about in the same way as the particles of aniline in the water act on the ordinary light; it is not irrational to assume that the refractive index for small wave lengths is unity; he thinks he is justified to conclude that X-rays are ordinary transverse ether vibrations whose wave length is much smaller than those of the known ultra-violet rays; it is possible that they are contained in the spectrum of the arc light, and in platinum or lead vapors.

Electrochemical Action of Röntgen Rays on Bromide of Silver. Streinitz. *L'Eclairage Elec.*, May 9; abstracted from *Wiener Berichte*, Feb. 6.—Under the action of light the electric conductivity of haloid salts of silver varies; if a beam of light falls off a bromide of silver plate in a solution of bromide of potassium, a difference of potential is developed between this plate and another in the same solution; he tried to find whether Röntgen rays have an analogous property; a silver wire was wound around a tube of glass covered with chloride of silver, placed in an opaque box and subjected to the action of X-rays, the ends of the wire being connected to a Thomson galvanometer; the deflection was found to vary when the tube was in action, and the effect was attributed to the inductive action of the discharges of the current; when the action of the tube was stopped there was a much larger deflection, which shows that these rays increase the conductivity of the chloride of silver. In measuring the E. M. Fs. positive results were also obtained; a small plate was covered with bromide of silver and placed with another electrode in a dilute solution of bromide of potassium, the plates being connected to a quadrant electrometer; a candle at 45 centimetres produced a diminution of the E. M. F.; under the influence of X-rays a similar though smaller deviation was produced. (An abstract of this article appeared in the *Digest*, May 23, but the original from which it was taken was not sufficiently clear.)

Röntgen Rays. Lond. *Elec. Rev.*, May 22.—Lafay succeeded in deflecting the rays when they had previously been passed through an electrified metallic plate; it was suggested in connection with his earlier experiments that the deflection of the rays might have been due to the combined effect of the magnet and the electric field developed by the electrified plate; to remove this uncertainty in his later experiments the electrified ray was caused to pass into a Faraday case connected to the earth, before being subjected to the action of the magnet and the deviation of the rays was found to take place as before; the phenomena does not take place if the aperture in the case is closed by a plate opaque to the rays. Another communication to the French Academy by that author is briefly noticed, in which he concludes that X-rays emitted from Crookes tubes are generally, though not always, positive rays; he thinks the feebleness of the electric charge in the ordinary rays may account for the failure to obtain any deflection of these rays with a magnet; the electric charge will also be rapidly dissipated within a short distance of the tube owing to the conductivity noticed in the surrounding region; he found that an electrified screen dissipated its charge at a rate proportional to its density and that the best dissipators are the best absorbers.

Röntgen Ray Photography. Raveau. *Rev. Gen. des Sc.*, April 30.—A long article of a general nature, including a number of good reproductions, among them those of various animals, and of fractured bones. Several reproductions of what have been called electrographs are also given as made by Narkievicz; one of them is of the hand which was made one of the poles of a condenser, the other pole of the coil being connected to a metallic rod in the interior of a tube filled with water; the tube is placed on a table above which is the sensitive plate on which the hand is placed; (the illustration merely shows the surfaces where the hand touched the plate, which was surrounded by hair-like fringes).

Reducing the Time of Exposure for Röntgen Ray Photographs. Meslin. *Rev. Gen. des Sc.*, April 30.—A short article showing that by the use of a magnetic field, which is not uniform, the rays in the interior of a tube may be suitably bent so as to focus themselves on one point of the glass; it is necessary that the field should not be uniform in order that some of that rays may be deflected more than others, so as to bring them all to one point.

Röntgen Tubes. Koenig. *Elek. Zeit.*, May 14.—An illustrated description of some focussing tubes, which he has found very useful; they are practically identical in principle with the one illustrated in the *Digest*, May 30.

Lag and Lead. Mordey. Lond. *Lightning*, May 21. A reply to the criticisms of Harrison (see *Digest*, May 16).—He quotes from his original remarks and those attributed to him by Harrison, and claims that the latter ignores the point at issue, and advances as new a threadbare explanation of something that was never in question; the point at issue is not a dispute as to facts, but as to the way those facts are usually set forth; he wishes to prevent a misunderstanding by drawing attention to a misleading explanation which is common in electrical literature. When a circuit has self-induction or capacity the current is not in phase with the applied E. M. F., but is in phase with the resultant E. M. F.; although both these E. M. Fs. are a quarter phase from the applied E. M. F., there is a difference between them, the E. M. F. of self-induction being in the opposite sense or direction to the E. M. F. of capacity, that is, they are 180 degrees apart, and since the effect cannot proceed the cause "it is doing less violence to our sense of right and wrong to say that the one is 90 degrees and the other 270 degrees behind the applied E. M. F.;" the lag is 90 degrees in each case, but the direction or polarity of one is opposite to that of the other; to say, as is usually done, that the E. M. F. of capacity precedes the impressed E M. F., although convenient for certain purposes, carries with it the disadvantage of incorrect appreciation of what are the real physical conditions, because it states that the current, which is the effect, precedes the impressed E. M. F., which is the cause of it.

Influence of Light on the Character of Influence Machine Discharges. Elster and Geitel. Lond. *Elec.*, May 22; a translation of a short paper from the *Weid. Ann.*, No. 3, page 401.

Röntgen-Ray Tubes. Hutchins and Robinson. *Sc. Amer.*, May 30.—An illustrated description of an improved tube which, among all of the many that they have tried, was the most effective; the tube is cylindrical with a concave cathode at one end and a platinum plate forming the anode, near the other end but inclined to the axis of the tube at an angle of 45 degrees and situated at or beyond the focal point of the cathode; opposite the inclined anode there is a hemispherical enlargement on the side of the tube through which the X-rays pass, the glass there being as thin as is consistent with strength; the platinum anode becomes hot and is practically the source of the rays.

Current for Vacuum Tubes. GREEN. *Elec. Eng.*, May 27.—A brief description of a device which he is now using for generating current for vacuum tubes, as also for testing the vacuum in incandescent lamps, the source of current being a 2000-volt alternating system; it seems to consist merely of an ordinary 300-watt transformer which is used as a step-up instead of a step-down transformer, the primary current for the low voltage winding in this case being regulated by passing it through a bank of lamps in multiple; for testing incandescent lamps, rods are connected to the secondary circuit, and are held on each side of the lamp bulb; he also found it very useful for testing insulation joints or couplings for combination fixtures.

Phosphorescent Diamonds. KUNZ. *Elec. Rev.*, June 3.—After a careful examination of a large number of diamonds, he finds that only certain ones fluoresce on exposure to the "ultra-violet rays of an electric or other strong light," and he therefore concludes that this phosphorescence is a property only of those diamonds that contain a certain bluish-white substance and that it is this substance and not the diamond which fluoresces; he thinks it is a hydrocarbon.

Photographs of Incandescent-Lamp Filaments. Elec. Eng., June 3.—A reprint of the illustration described in the *Digest*, May 16 (see also June 6), in an abstract of a note by Cassells.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Solution of Carbon. COEHN. *Zeit. f. Electrochem.*, May 20; a reply to the recent criticism of Vogel (see *Digest*, May 16).—The latter stated that Matteucci, von Babo and Brande had succeeded in depositing carbon in a kation; Coehn quotes extracts from the articles of those writers (Brande 1831 and von Babo 1857), showing that Brande himself stated that the deposit was due to the impurities of the materials used; he electrolized compounds of carbon with a mercury anode and obtained a deposit on the mercury which he states was due to traces of calcium; von Babo obtained a real deposit of a resinous material, but nothing more; Vogel is right in saying that Coehn obtained carbon, not as a kation but in the kation; he will discuss this important point more fully when he publishes his complete results; he suggests that there may be a difference of opinion as to what constitutes a solution; Vogel seems to consider such a solution, as one containing carbon as such; a solution of sulphate of copper, for instance, does not contain the metal as such, and a solution of carbon is like that of any other element containing the carbon as a combination, and it is this solution which he has decomposed into ions; he is now occupied in analyzing these ions and asks for a postponement of further discussion until he has published his results. He states that cases have been recorded in which a true deposit of carbon was obtained on the cathode; Mendelejeff states that with a weak current through a liquid compound of chlorine and carbon powdered diamond is deposited on the negative electrode; it is thought that he referred to the work of Despretz, who obtained a diamond powder on a platinum electrode by passing a weak current for two months through acidulated water; he also obtained green crystals on the positive pole by a weak current for six months through an alcoholic solution of a compound of chlorine and carbon, while on the negative pole there was a brown, warty substance having the same hardness as diamond; it is also generally known that traces of carbon are contained in the deposited metals in an electrolytic bath.

Electric Endosmose of Tannic Acid Through Hides. ROEVER. *Jour. Inst. Elec. Eng.*, May; a longer abstract of the article noticed in the *Digest* last week.—The summary of his conclusions are given as follows: 0.2, 0.3 and 0.5 per cent. solutions of tannic acid were only slightly forced through the hide by the hydrostatic pressure, but were carried through in considerable quantity by the electric current. The liquid was moved in the same direction as the current. The effect in the first minute is proportional to the E. M. F. applied, but is not proportional to the current strength. The quantity of liquid transferred and the current strength decrease after the current has passed for 0.2–8 minutes in the same direction. On reversal, the current increases to a maximum in 0.2–8 minutes and then decreases again. In order to promote the circulation of the tan liquor in the pores of the hide by the electric current, the current should be reversed at short intervals—say every minute.

Boese Accumulator. L'Eclairage Elec., May 16.—An article giving the data for some installations of these accumulators, which are said to be used largely in Germany; the plate is made by mixing minimum with alcohol, containing a solution of the residues of the distillation of tar, especially anthracene; the paste is placed in a rectangular frame of lead, which serves as the conductor; after drying, it is hardened in dilute sulphuric acid; the material is said to be very porous; there is no grid; these accumulators are used on the German and Hungarian postal railway cars, where, it is stated, that 20,000 cells are in use; the data for these installations is given, showing a capacity of 25 ampere-hours per kg. of plates; they are also used in the Stettin central station, in which 4600 ampere-hour cells are installed.

Electric Treatment of the Minerals at Broken Hill, in Australia. ANDREOLI. *L'Eclairage Elec.*, May 16.—The beginning of an article, describing the electrolytic process used at this mine, chiefly in connection with silver, zinc and lead.

Jacques Carbon Battery. El'ty, June 3.—An editorial criticism calling attention to some unfavorable features and the absence of important data. It ought to have been stated how much energy is required to pump the air into the electrolyte and how much fuel is required to keep the electrolyte heated; the carbon is spoken of as coal, but it is evident that this would have too high a resistance, and it is probably in the form of a carbon electrode which could probably not be bought for less than $120 per ton; caustic potash absorbs carbonic acid much more rapidly in the fused state when air is blown through it, and the destruction of it is still more rapid if the oxidation of the carbon produces carbonic acid; if carbonic oxid and not carbonic acid is produced, then an efficiency of 82 per cent. is impossible; even the best carbon is not pure, and the impurities which remain behind combine with the electrolyte, which in time would thereby become so infusible as to require renewal; the electrolyte must therefore be replenished as in other batteries.

Mr. Reed in the *Elec. Eng.*, May 27, also criticises this battery unfavorably; he states it is not certain that it is a primary battery at all; the amount of carbon consumed outside of the pots ought to have been stated and it is probably many times as great as that consumed in the inside; he believes it to be merely a thermoelectric battery and that the consumption of the carbon is a result of the current instead of being its source; the current obtained in the test of this battery (see *Digest*, May 23) is electrochemically equivalent to 7.5 pounds of carbon, and if it was obtained from the 8 pounds consumed in the pots, the efficiency would be 94 per cent. A further criticism by Mr. Reed is contained in an editorial in THE ELECTRICAL WORLD of last week.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measurement of Very High Potential Differences. ABRAHAM and LEMOINE. *Jour. de Physique*, 4, page 466; abstracted in the *Jour. Inst. Elec. Eng.*, May.—They maintained a constant potential by means of an influence machine kept at a uniform velocity by means of a small electric motor and producing a permanent discharge between the poles, one of which was connected to earth and the other to the inner coating of a jar the outer coating of which was grounded; the inner coating then showed a very nearly constant potential which varied only about one tenth of a per cent. during six minutes; the method enables voltages between 5000 and 50,000 to be accurately measured; a description of the absolute electrometer similar to that of Lord Kelvin, is given in the abstract and it is stated that a voltage of 40,000 can be measured accurately to 40 volts; the instrument could be used as an absolute one as long as the distance between the discs did not exceed half the breadth of the quadrant ring.

Sullivan Universal Galvanometer. Lond. *Elec. Rev.*, May 22.—A communication from Fournier, the electrician in chief of a large French company, giving his opinion of the instrument, based on its use on a cable ship under adverse circumstances. He praises the instrument very highly and is entirely satisfied with it; it is easily adjusted, well designed, has a very high sensitiveness and was sufficiently aperiodic; he considers that it fulfills every requirement on board ship and leaves the old marine instrument far behind. (It is a galvanometer of the movable coil type arranged for sea use; in it the question of making the spot of light immovable in the roughest sea, is said to have been successfully solved and with great simplicity.)

Modified Mascart Method for Using the Quadrant Electrometer. ARNO. *L'Eclairage Elec.*, May 9; abstracted from *Elettricista.*—In the method of Mascart the two pairs of quadrants are connected to the two poles of a battery, of which the middle or neutral point is connected to the earth, the needle being connected with the potential to be measured; whenever a difference of potential is to be measured this method requires making two measurements; to avoid this and to enable a difference of potential to be measured between two points A and B, with one reading, the point A is connected to the needle and the point B to the middle or neutral point of the battery.

Use of the Ballistic Galvanometer when the Transient Current is not of Short Duration. WEISS. *Jour. de Physique*, 4, page 420; abstracted in the *Jour. Inst. Elec. Eng.*, May.—When it is used for measuring the difference of two opposite inductions, the two E. M. Fs. do not always commence at the same instant if the Foucault currents in the adjacent masses of metal oppose the two opposite inductions unequally; he found by experiment that the retardation of one of the E. M. Fs. does not influence the strength of the impulse; it is also immaterial whether the opposite induced E. M. Fs. commence simultaneously or whether one lags appreciably behind the other owing to Foucault currents.

Indicating and Measuring Open-Circuit Currents. NICOLAIEVE. *L'Eclairage Elec.*, May 9.—A mathematical article describing two methods for studying such currents and the displacement currents in dielectrics.

In the issue of May 16 there is a further article by the same author on electric displacement currents and the variable magnetic induction of iron.

Protecting Instruments from Electric Railroad Currents. CORSEPIUS. *Elek. Zeit.*, May 14.—A short article discussing the method in which the instruments in laboratories are protected by wires leading to various points of the circuits.

Use of the Telephone for Measuring the Dielectric Constant of Conductors. Heydweiller. *Elek. Zeit.*, May 21; abstracted from *Wied. Ann.*, Vol 57, page 694.—He shows the limits between which this method may be used.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Lines. West. *Elek. Zeit.*, May 14.—The beginning of a series of articles giving illustrated descriptions of some notable features of telephone lines in foreign countries, the present portion referring to the iron and wooden poles used in Holland.

Cable Laying on the Amazon River. Siemens. Lond. *Elec.* and *Elec. Rev.*, May 22.—An abstract of a Royal Institution lecture, in which he describes the recent laying of this cable.

International Telegraph Conference. Lond. *Elec. Rev.*, May 22.—An abstract of a circular signed by F. Gd., commenting on the necessity of the unification of international rates, and the simplification of the accounts.

Central Station Telephone Switch. Mattausch. *Zeit. f. Elek.*, May 15—A long, illustrated description of his switch for single and double circuits taken from a patent specification.

Telephone Exchanges and Their Working. Sinclair. *Jour. Inst. Elec. Eng.*, May.—A reprint of the complete paper, which was recently noticed in the *Digest*.

Government Telephone System in Denmark. Elek. Zeit., May 14.—A brief, illustrated description including a map of the circuits.

Telephonic Transmission of the Roar of Niagara Falls. Dunlap. *West. Elec.*, May 30.—A brief, illustrated description of the transmitter which was used for carrying the sound to the exhibition in New York; it is located at a point near the Cave of the Winds, and consists of a telephone with a solid back transmitter and a 20-inch sheet iron funnel 14 inches in diameter at the outer end; there are two distinct sounds, one a sharp, hissing sound made by the water over the rocks and the other a deep, roaring sound.

MISCELLANEOUS.

Haemostat. Lond. *Elec. Eng.*, May 22.—A brief description of an instrument by Tait intended for arresting bleeding in surgical operations: A platinum wire carrying a current is enclosed in the blades of a pair of steel forceps, the wire being insulated by pipe clay; with this the arteries are seized and pressed and in a few seconds the tissues and arterial walls are so agglutinated that the passage of blood is rendered impossible; the temperature is only about 180 degrees Fahr. which shows that the principle is quite different from that of electrical cauterizing instruments; it removes the necessity of a ligature.

Silicate Copper Alloy. Vigouroux. *Comptes Rendus*, No. 6; abstracted in the *Jour. Inst. Elec. Eng.*, May.—The material is produced by placing a mixture of pure silicum and copper in an electric furnace in which they will combine in a few minutes to form a homogeneous liquid; the proportions were varied and the properties of the different alloys are given.

New Book.

Electric Lighting. A practical exposition of the art for the use of engineers, students and others interested in the installation and operation of electrical plants. Vol. I. The Generating Plant. By Francis B. Crocker, E. M., Ph.D. New York: D. Van Nostrand Company. London: E. & F. N. Spon. 438 pages; 152 illustrations. 1896. Price, $3.00.

The author's aim is to produce a practical exposition of the art of electric lighting for the use of engineers, students and others interested in the installation or operation of electric plants. The volume before us treats of the generating plant; a second volume will treat of the distributing conductors, lamps, special applications, etc. The plan of the work is to follow the natural sequence of the transformations of energy—boiler, steam-engine, dynamo, lamp—and every subject is treated in its proper place in that sequence. This arrangement facilitates a logical presentation of the matter, and the volume before us is well and clearly written. If completed in the same style it will form an excellent text-book for students of electrical engineering.

Some of the admirable features of the work may be mentioned.

The author has been mindful of the advice given by Horace to aspirants to poetical fame not to begin their poem with the origin of the world, but to plunge at once into their subject proper. Prof. Crocker does not begin with the horseshoe magnet and iron filings; he leaves the principles of electricity and magnetism to elementary works, and proceeds at once to the art of electric lighting.

In the case of each topic an extensive list of references is given to papers or books where the original or fuller treatment of the subject may be found.

The information given is up to date. Only the most modern and typical cases of machines and methods are described, while doubtful or less important instances are merely referred to.

There is a chapter on general units and measures, which gives convenient tables of the factors for converting the English units into metric units and reciprocally. It also gives the definitions of the electric units which were adopted by the International Electrical Congress, which met at Chicago, and have since been legalized by the United States, England, Germany and other countries.

Not many formulas are given, but those given are the fundamental ones, and the writing is everywhere that of an exact man.

Two More Exposition Exhibits.

During the past few weeks The Electrical World has given up much space to the description and illustration of the individual exhibits at the recent Electrical Exposition in New York. We give herewith illustrations and brief descriptions of two of the exhibits, which were notable in their respective classes.

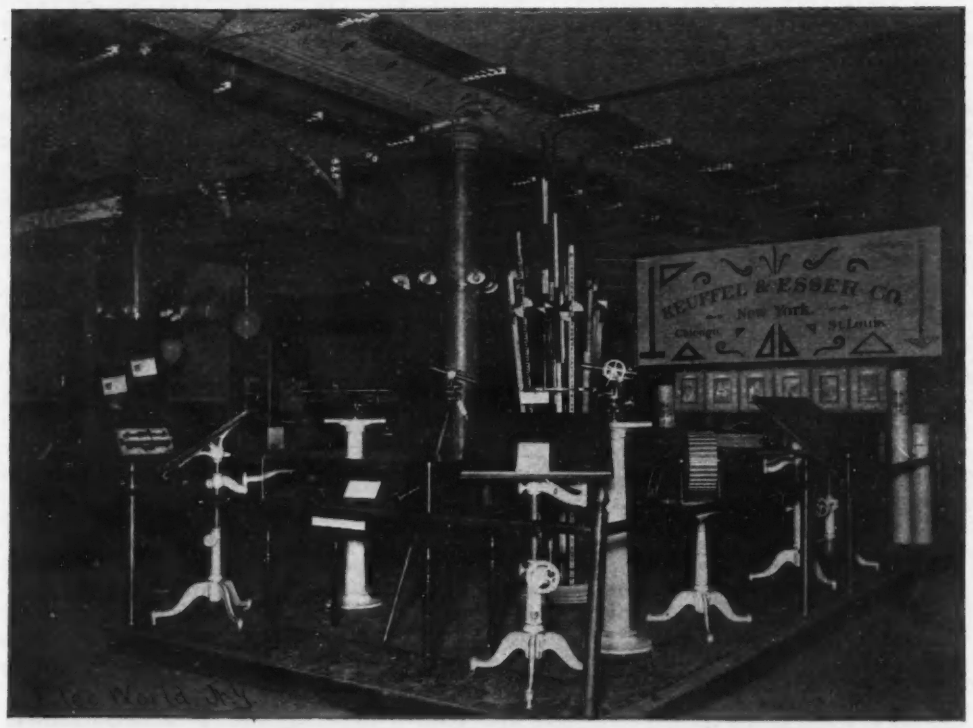
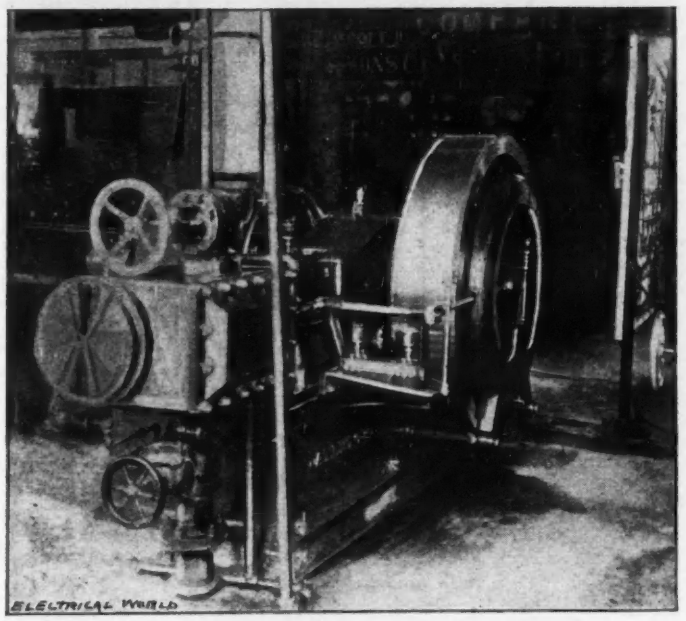


Exhibit of the Keuffel & Esser Company.

The Keuffel & Esser Company, New York, occupied a very prominent location with their exhibit. It consisted of surveyors' rods and other

surveying instruments, adjustable draughting tables, sample rolls of drawing paper, etc., and in two show cases were shown a fine line of Paragon drawing instruments and scales for draughtsmen's uses. The excellence of this company's goods are well known in the electrical engineering profession.

THE WATERTOWN STEAM ENGINE COMPANY, Watertown, N. Y., had one of the first of the steam exhibits operating at the opening of the Expos tion. The exhibit consisted of a 60-hp 10 x 12 engine, which was

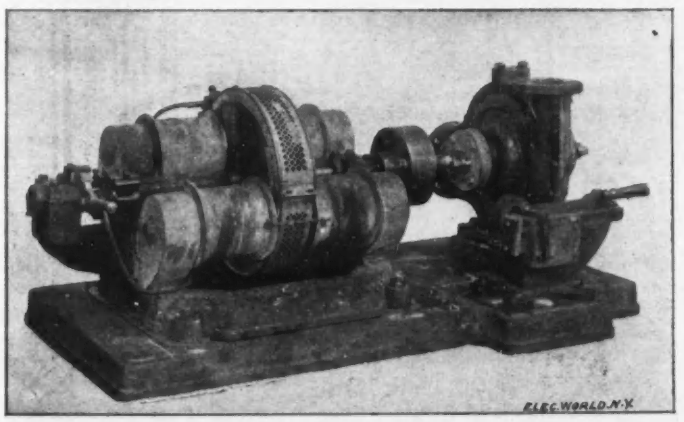


WATERTOWN ENGINE EXHIBIT.

direct-connected to an Eddy generator. The combination is shown in the above illustration. Mr. L. Copleston, the New York representative of the Watertown Steam Engine Company, very ably looked after the company's interests during the exposition. The engine did some good work during the exposition period, carrying a very heavy overload most of the time.

A Portable Electrical Pump.

It frequently happens in various industries, and particularly in mines, that it is necessary to transport from one place to another a pump to be used for draining purposes. The firm of Fabius Henrion, Nancy, France, constructs a type of portable pump which is very interesting, and which is shown in the accompanying illustration. It represents a centrifugal pump directly coupled on a common base with an electric motor. The base carries beside a patented hydraulic starter, which is seen in the forward part of the illustration. This apparatus, which is very simple,

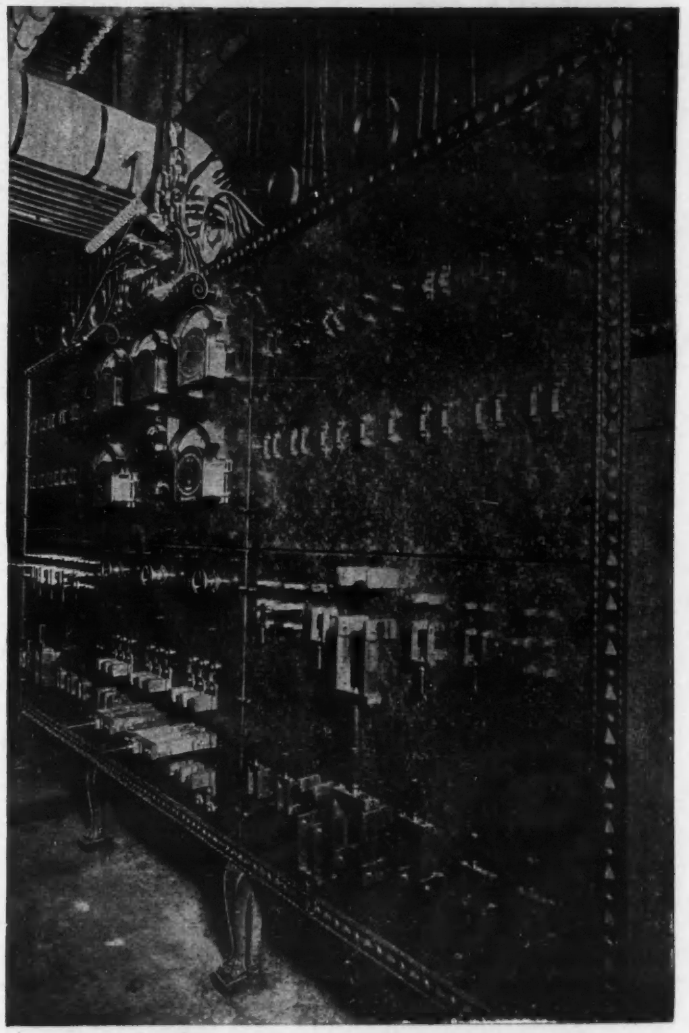


ELECTRICAL PUMP.

permits of starting and stopping the pump as readily as with a rheostat. It is composed of a corrugated metallic plate plunged into a metallic box, which contains a salt solution. One of the poles of the generator is directly connected to the motor, the other pole connected to the metallic box, and the second binding post of the motor is connected to the plate. The latter is, of course, insulated from the box. When the plate is plunged into the liquid the current flows through the conducting liquid, then through the plate and to the motor, which commences to turn. The plate is balanced by counter-weights and will remain in any position. It is made so that one may start up as slowly as desired, or by quickly raising the plate the current can be instantly shut off in case of necessity. The small device which is seen on the side automatically assures an excitation of the motor before the main current flows through the armature, and also cuts off the exciting current at the same time as the main current. This apparatus can be adapted to all kinds of machine tools, and constitutes a kind of electrical starter, which is very simple and can be manipulated by one simple movement. The electrical pump is constructed for all outputs and for pumping to elevations of from 1 to 60 metres, by coupling several pumps in series on a common base and operating them by a single motor.

Hotel Switchboard.

The accompanying illustration represents a large switchboard recently installed by the Technic Electrical Works, Philadelphia, at the plant of the Hotel Walton. The electric plant consists of three generators of



SWITCHBOARD IN HOTEL WALTON.

100-kw capacity each. Current is distributed by 28 circuits for the lighting of the building, also for the elevators, fans and other power work.

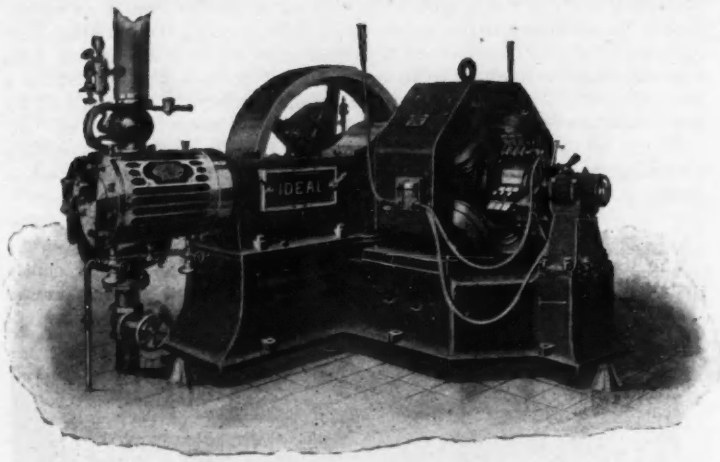
An "Ideal" Combination.

The Harrisburg Foundry & Machine Company, through its New York representatives, W. R. Fleming & Co., in association with H. B. Coho & Co., had on exhibition at the National Electrical Exposition a 75-hp Ideal engine, direct-connected to a 50-kw Eddy dynamo, an illustration of which is here shown.

This combination was supported on three steel pins, having a total area of contact of three square inches, without the use of foundation bolts or fastenings of any kind. This combination of engine and dynamo merely rested on the pins, which were squared off to receive the bed plate without recourse to counter-sinking at the points of contact, reliance being placed entirely on the perfect balance of the reciprocating parts and weight of the machine to keep it in place. This machine ran every exhibition day and evening at a speed of 300 revolutions per minute, doing its full share of work, and often sustaining a 20 to 30 per cent. overload.

During the progress of the exposition indicator cards were taken from time to time under variable conditions of load, which showed excellent economy in the distribution and use of steam as well as efficiency of regulation. But perhaps the most remarkable showing was obtained

when engine and dynamo were running free under no load, when cards showing a frictional resistance of less than 2 per cent. of the capacity of

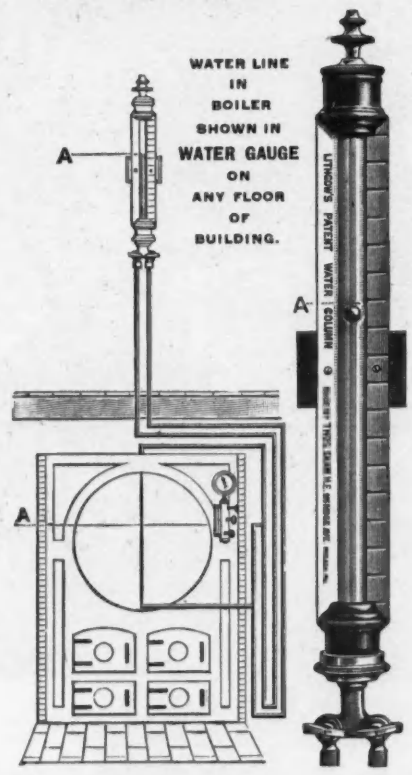


Engine-Dynamo Combination.

the combination were repeatedly taken and freely distributed to the patrons of the exposition, among whom were many prominent engineers.

Water Gauge.

The Leithgow water gauge, manufactured by T. Shaw, Philadelphia, Pa., and illustrated herewith, can be located on a floor above or below the boiler, thus rendering it practicable for the superintendent or manager to watch over the water supply in the boiler from his desk.



Water Gauge.

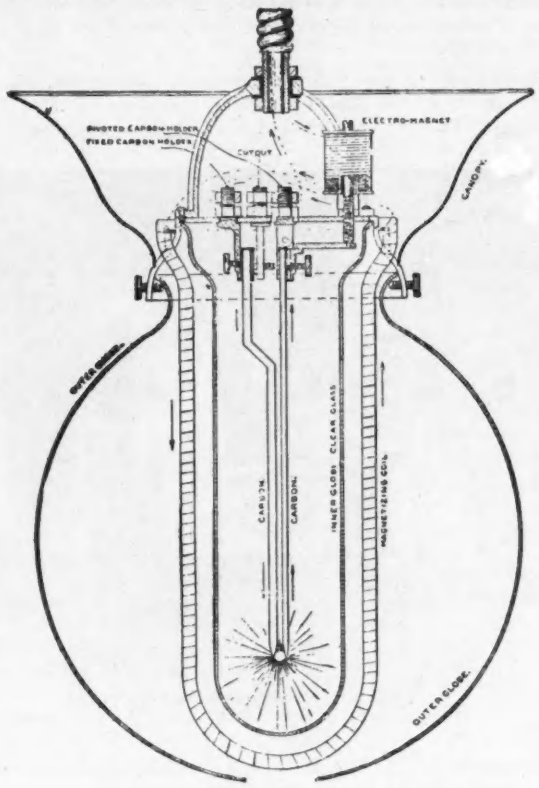
The Leithgow gauge is an old one, but on the death of its inventor it fell into disuse. Lately, however, calls have been made for it, and Mr. Shaw has taken up its manufacture.

The water line of the boiler is shown on this gauge, when placed at a point distant from the boiler, as accurately as if it were connected with the boiler in the usual manner.

Boilers located in the cellar of a building can be watched from the floor above, and a boiler on the second floor can be looked after on the lower floor—in the office, for instance. In this way the condition of the water supply can always be ascertained without going into the boiler room. The instrument acts on the principle of a hydrostatic balance.

New Arc Lamp.

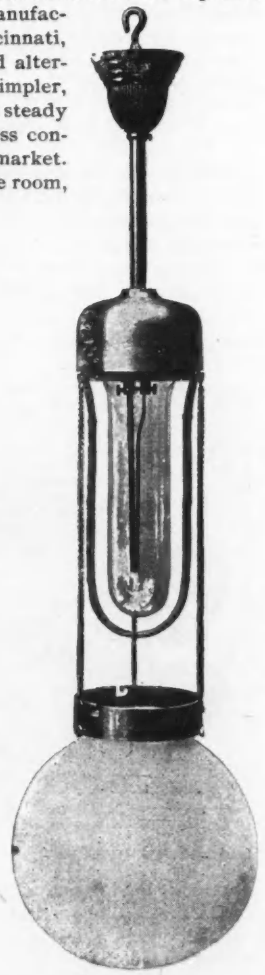
The Nowotny arc lamp illustrated herewith is of an entirely new type. The following are its main features: The carbons are placed parallel to each other throughout the entire length which is to be consumed by the arc; they are flat, the two flat sides being close to one another; the arc is kept at the tips of the carbons by the use of a magnetic field; this field is generated by a coil which lies in a plane parallel to the axes of both carbons; the carbon holders and carbons are encased in a single glass globe, to protect them from the access of fresh air, thus greatly prolonging the life of the carbons; the only moving part of the lamp is one carbon holder, which is pivoted so as to move sufficiently to allow the



Cross-Section of Lamp.

carbons to come into contact at their tips, or to separate to the distance necessary for the required arc; a single solenoid magnet is provided to draw up an arm, fastened to the pivoted carbon holder so as to separate the carbons from the arc. This lamp is manufactured by the Nowotny Electric Company, Cincinnati, O., for arc, constant potential, continuous and alternating-current circuits, and is claimed to be simpler, more reliable, and to give a more uniform and steady light with a less amount of attention and a less consumption of carbon than any other lamp on the market. This lamp casts no shadow, and occupies little room,

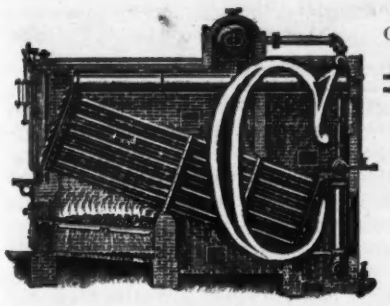
Lamp Complete.



Lamp with Globe Suspended.

and is said to be the shortest lamp made. It has no rods, no sliding contacts, no chimney, no clockwork and no springs. It is provided with an automatic cut-out, is easy to trim and is ornamental.

Water Tube Boiler.

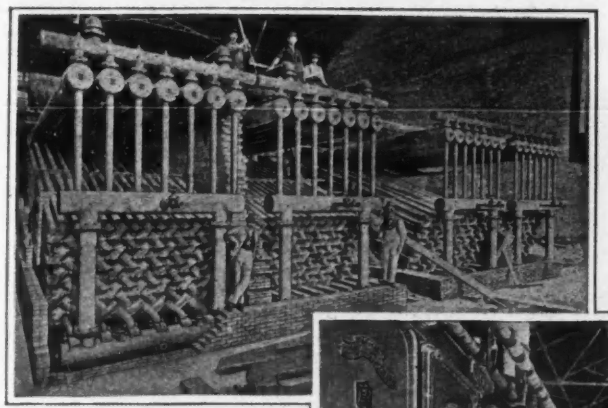


COINCIDENT with the rapid improvements in electric lighting and electric railway generating apparatus have been improvements in steam generators and steam engines. The exacting requirements of electric lighting in the matter of regularity of speed and power, laid upon builders of boilers and engines the necessity of so improving their apparatus as to meet the new conditions, and that they have successfully met these demands is evident to those who are at all familiar with the various first-class boilers and engines now upon the market.

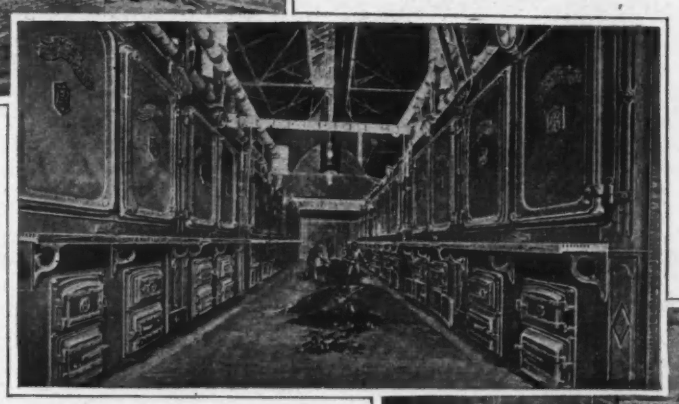
A steam boiler for electric lighting and electric power work must be able to maintain a constant pressure, and the pressure must not fall at full load. It must also be able to take care of wide variations in the load which frequently occur in electric lighting, and are a prominent feature of the operation of electric railways. To take up these variations boilers must be quick steamers and not liable to disastrous explosions.

Water tube boilers are very largely used in electric light and electric railway stations and other steam plants throughout the country on account of possessing these qualities in a high degree, and for the ease with which they can be repaired and transported.

Among the foremost types of water tube boilers are those manufactured by the Abendroth & Root Manufacturing Company, New York. This make of boilers, a perspective view of which we give herewith, has been on the market since 1867, and is of the true sectional water tube type. As showing how easy it is to effect repairs it is stated that any of its parts can be replaced in less than two hours, without the services of a practical boiler maker. It produces dry steam, and is capable of carrying high pressures. Owing to its water circulation it is a rapid generator of steam and is said to hold its pressure constant under the greatest varying demands for steam. The rapid and even circulation of the Root boiler is one of its prime features, as upon this depends its rapid action as a steam generator.



ROOT BOILERS AT WORLD'S FAIR.



ROOT BOILERS, TUNNEL PLANT, B. & O. R. R.

Regarding its mechanical construction, it may be stated that all its parts are interchangeable, so that repairs may be effected in the shortest time possible ; and in the matter of repairs it is a very economical boiler.

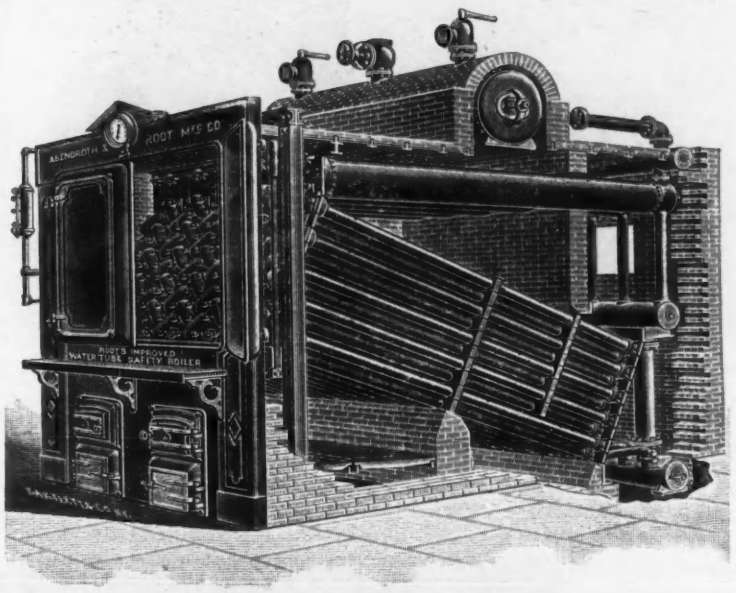
In installing a boiler of the ordinary tubular type it is frequently necessary to tear out side walls or dig up the street, but in the case of the Root boiler all this is changed, an opening 40 inches square being all the space that is necessary to get it into a building. That, of course, admits the largest part of the boiler. Forty inches square is a very insignificant area indeed as compared with the opening required to pass a bulky, old-fashioned boiler inside of a building. Another important advantage possessed by the Root boiler is that its capacity can be increased at any time at a minimum cost by placing additional packages of tubes on top or alongside of those already in the boiler.

To accommodate the unequal expansion and contraction which takes place in all steam generators of this type, this boiler is provided with a flexible and safe vertical section connecting the ends of the tubes to the overhead drum. The boiler does not feed cold water into its overhead drums, thereby reducing the heat of the water and steam contained therein below the normal heat corresponding to the pressure and rendering the producing of dry steam an impossibility. All of the mud contained in the feed water is received in the mud drum, which is shown at the back of the boiler.

Our group illustration shows three different prominent installations of Root boilers.

New Process Commutator Segments.

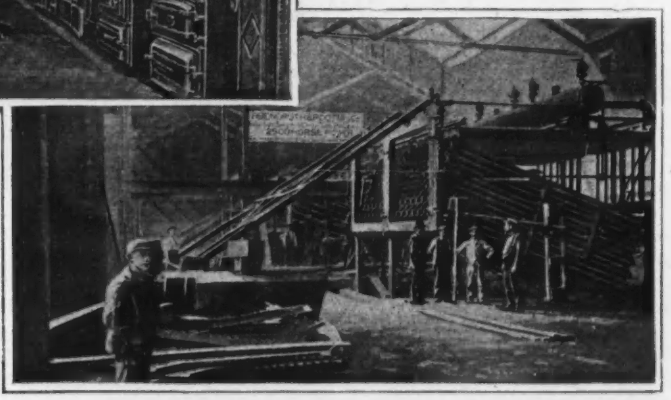
Ever since the invention of the dynamo and motor attempts have been made to produce the commutator segments in complete sets by milling them from the solid casting the shape and size of the commutator. This plan never became a practice or commercial success because of the time and expense necessary to produce them. Another cause of failure was the imperfect casting, especially when made of copper.



SECTIONAL VIEW OF WATER TUBE BOILER.

Both these objections have been overcome by the Miamisburg Electric Company, Miamisburg, O., which is now offering to the trade segments made in sets, cut from a solid copper cylinder the shape and size of the commutator required. The cylinder is then milled from the central bore outward on radial lines through the body of the cylinder, cutting the latter into as many segments as are required in the formation of the commutator.

The cuts, or kerfs, extend nearly, but not quite, through the rib which corresponds to the arm of the segment, leaving an uncut band of metal around the arms sufficiently strong to hold the segments together in exact relation. All that is necessary in building the commutator is to insert mica, clamp the segments in the usual manner and finally separate them with a hack-saw or turn off the solid ring of metal.

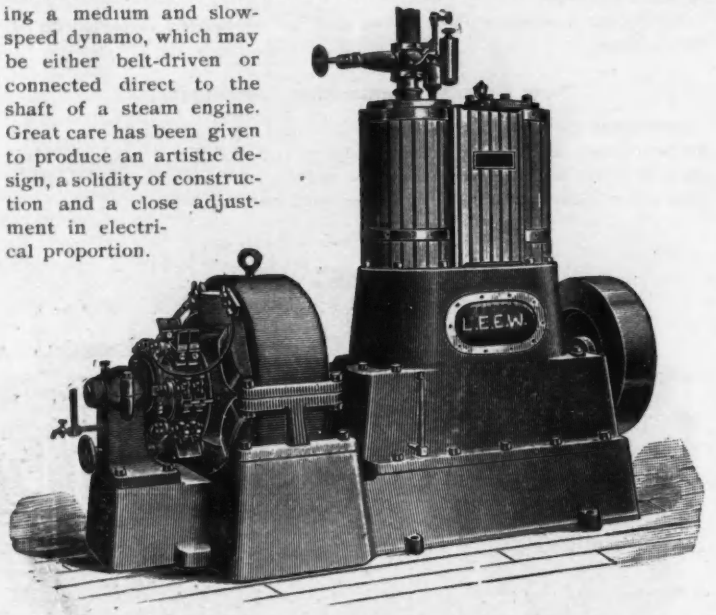


ROOT BOILERS, CINCINNATI STREET RAILWAY CO.'S POWER-HOUSE.

Segments made by this process have many advantages that commend them to the manufacturers of small dynamos and motors. Being cast at one time all are of equal density and hardness.

New Multipolar Dynamo and Motor.

We illustrate herewith a new six-pole multipolar dynamo which is being introduced by the LaFayette Engineering & Electric Works, LaFayette, Ind. These machines are made in sizes from 17½ kilowatts to 90 kilowatts, and have been designed with a view of obtaining a medium and slow-speed dynamo, which may be either belt-driven or connected direct to the shaft of a steam engine. Great care has been given to produce an artistic design, a solidity of construction and a close adjustment in electrical proportion.



Direct-Connected Multipolar Dynamo.

The armature, except in the smaller sizes, is of the toothed type, but has several important modifications in its details. Each coil is independent of the other, which allows the easy replacing of an injured coil in case of accident.

Both armature and commutator are thoroughly ventilated, and the fields have a large radiating surface so that the heat is readily dissipated. The field coils are wound separately on suitable forms, and are held at a short distance from the pole-pieces so as to allow for an air space to ventilate the inner surface of the spool.

The magnet frames and pole-pieces are cast from a special soft steel of high magnetic qualities and are bolted to a heavy cast-iron base, thoroughly braced and proportioned to absorb vibration.

Special attention has been given to the commutator which presents a large and ample surface for the brushes, and permits any variation of load without sparking. The brush holders are mounted upon a rocker arm and may be shifted simultaneously upon the commutator face; at the same time they are so constructed that each brush has an independent adjustment of tension and position.

This multipolar dynamo is compound-wound and ordinarily arranged to maintain a practically constant potential.

The slow-speed motors are similar in construction and appearance to the dynamos, and by changing the field coils the motor can be changed to a generator for lighting or power purposes, or *vice versa*.

In addition to the new multipolar machine, the company manufactures a regular line of bipolar apparatus which contains some valuable features.

The Walker Company.

This company was recently organized under the laws of New Jersey, with a capital stock of $2,500,000, to purchase the entire plant and property of the Walker Manufacturing Company, Cleveland, O., and several other electrical companies controlling valuable business and patents. The new company includes some of the strongest financiers and capitalists in the country, and the working capital has been greatly increased. It has acquired a new factory in New Haven, Conn., and will make extensive additions to its Cleveland plant. Among those who are interested in the new enterprise are ex-Gov. Flower, of New York; J. W. Hinckley, Anthony N. Brady, Mr. Belmont, Dallas Sanders, William Rotch, Parker C. Chandler, Frank Billings and Jacob B. Perkins.

The company's immense plant at Cleveland is now devoted exclusively to the production of electrical apparatus, and with the extension at this point and the addition of the new plant at New Haven, the company expects to be amply able to meet the increasing demand for its apparatus, which demand is now expanding as a result of the recent combination of two large electric manufacturing concerns.

Electric Vehicles.

The American Electric Vehicle Company, a corporation a with capital stock of $250,000, incorporated under the laws of the State of Illinois, seems to have in its possession all the elements of the perfected electrically propelled vehicle, which is the result of the labors of Messrs. Woods, Corrigan and Culver, officers and directors of the company, covering a period of nearly a year. The vehicles brought out by this company have all the luxuriousness, finish, trimming and personal comfort that has always been used in strictly high-grade carriage productions, and the entire construction as a carriage product is second to none of any kind in these particulars. The electrical equipment, designed and manufactured by this company exclusively for this work, is the result of a careful and systematic study concerning the conditions to be met, combined with a long prior experience in the application of electric power for all purposes which have been developed and perfected in other lines. These vehicles have been in daily operation in the streets of Chicago for over a month, and give every evidence of a perfectness which could hardly be conceived as possible so early in their introduction.

Electric Mail Phaeton.

The mechanical design and arrangement of the vehicles is entirely individual with the company, having been studied out as carefully in its steering gear and braking devices, etc., as the electrical equipment itself was. Ball-bearing axles and rubber tires are used in connection with the wheels, and in every design of vehicle, with one exception, two motors are used. These motors are dust and water proof; they are built in different sizes for the different carriages, and are arranged in series-parallel control, much like street car equipments.

The batteries used by this company are built and designed by one of the oldest companies in this line of business.

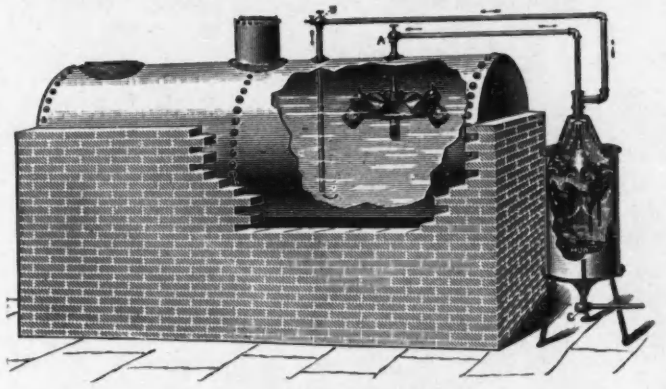
The entire line of vehicles as being developed and worked on by the

Electric Vehicle Company, embraces over 20 different designs, equipped for any and all the different conditions met in the use of pleasure carriages and light delivery work.

Floating Skimmer and Boiler Purifier.

The device herewith illustrated is designed to remove the impurities from water used in a boiler, and prevent the formation of scale. Its action depends upon the difference in temperature in the upper and lower parts of the boiler. The impurities being hung in suspension near the surface of the boiling water are collected by the skimmer and forced to the settling drum, where they fall to the bottom after separation from the water; the purified water then returns to the boiler.

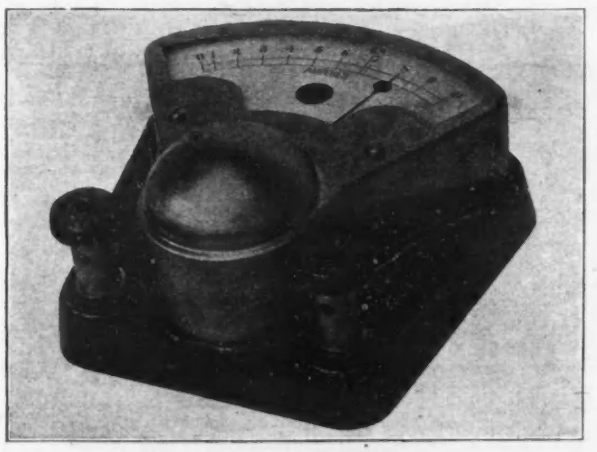
It is stated by the manufacturer of the Myers floating skimmer and boiler purifier, Thomas Aldcorn Company, Limited, New York, that this machine not only prevents the formation of new scale, but also removes old, as it extracts all mineral and vegetable matter from the water, leaving it pure. The skimmer always adapts itself to the surface of the water, its motion being vertical. It is stated, also, that boilers do not foam when fitted with this device.



SKIMMER AND PURIFIER.

Thomson Arc Circuit Ammeter.

Among the standard instruments which the General Electric Company has lately placed on the market, the Thomson arc circuit ammeter is one which will be found of considerable service where such a meter is applicable. This is a high-grade instrument for switchboard purposes and is mounted upon a black enameled metal base, while the cover, binding post and screws are of bright nickel. It measures over all 8 x 8 inches.

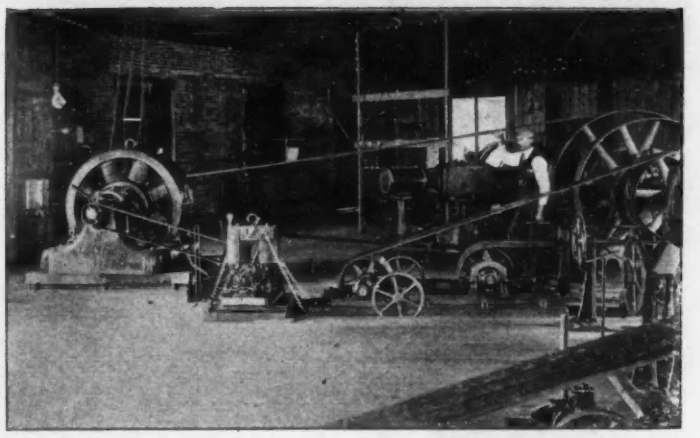


THOMSON ARC CIRCUIT AMMETER.

The qualities claimed for this instrument which should recommend it to those connected with arc lighting plants are its high degree of accuracy, its perfect reliability in service, together with an absolute dead beat movement of the pointer. The scale is long and may be clearly read from a distance. One ammeter may be used for either half or full arc circuit, the divisions being wide and calibration marked for both services. Permanency of calibration is obtained by the elimination from the instrument of any parts liable to change. Each ammeter is provided with a self-contained and conspicuous polarity indicator consisting of two signals, the white showing under normal conditions, the red on reversal, the latter remaining in sight until the current has once more passed through the instrument in the proper direction. The ammeter may be used for either front or back connection, posts and studs being furnished as conditions require. Several of these instruments were shown at the Electrical Exposition in New York, and elicited much favorable commendation.

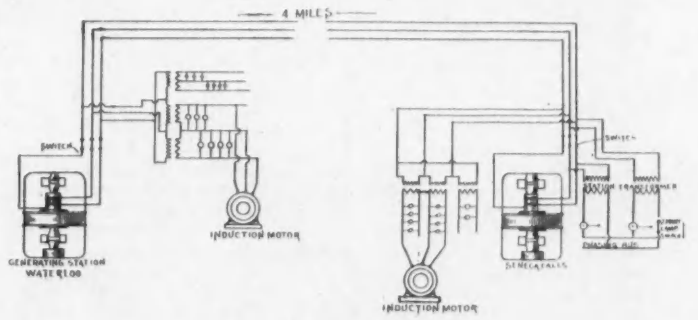
Seneca Falls Light and Power Plant.

The electric light and power plant at Seneca Falls, N. Y., is interesting inasmuch as it is the first case where alternating currents have been used under similar conditions. The plan of the installation as well as its successful operation have been carried out by Mr. N. T. Wilcox. The novelty consists in the use of two alternating-current machines located in stations distant from one another and operated in multiple under the conditions incident to every-day central-station practice. This company has installed two General-Electric 100-kw three-phase composite



SENECA FALLS POWER PLANT.

wound, 60-cycle, 2300-volt generators, one being located in the Waterloo station, about four miles from the main plant located in Seneca Falls. Lights and power are used at both ends of the line, a duplicate generator in the main plant being used only in emergencies or when desirable to shut down the Waterloo generator. These machines replace an Edison three-wire system in Waterloo and a 500-volt direct-current motor system and 1000-volt alternating-current single-phase lighting system in Seneca Falls. There is a large surplus of power at Waterloo during the greater portion of the night, and for this reason it is desirable to use this surplus power for street lighting, but owing to the fact that there is at times a scarcity of water, it is necessary to have arc dynamos in Seneca Falls where there is steam power for emergencies of this kind. Consequently, it is desirable to transmit this surplus to be used on the main shaft of the Seneca Falls station. This problem has been solved by synchronizing the generators and throwing them in multiple-working both lights and power over three-phase No. 6 B. & S. wires, which connect the two stations, which, as stated before, are nearly four miles apart. The Waterloo wheels are then run at full gate, transmitting their full power to the generator. The regulation is accomplished at the receiving end of the line in Seneca Falls. The surplus power not required for incandescent lighting supplies



PLAN OF DISTRIBUTION.

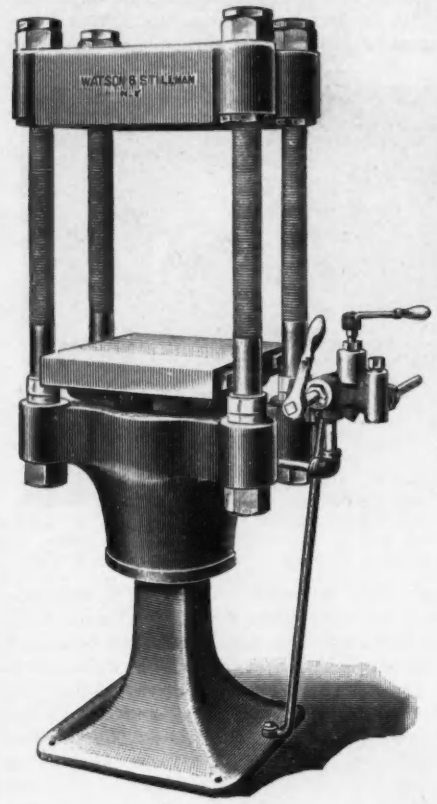
energy to drive the Seneca Falls generator as a synchronous motor, transmitting power to the line shaft as the lighting load falls off, thus utilizing more and more of the energy in driving the shaft, until the amount of power delivered to the line entirely relieves the engine of its load, and the steam power is then cut off. By carrying a strong field on the Seneca Falls generator, when used as a motor, all drop of potential due to inductance on the line is entirely eliminated. The working of the system is said to be admirable. The incandescent lamps at both ends of the line are under perfect control, and the gain in operating economy is noticeable.

Press for Electrical Trimmings.

The accompanying illustration shows a new hot, chilling or solid platen die-press, made by the Watson-Stillman Company, New York.

This press possesses several new features, and it is becoming very

popular among electrical manufacturers. The top platen is adjustable, and as it closely fits the rods the dies may be heated or chilled in the press while under pressure, the dies lying loose between the two platens. The upper platen is made adjustable for several inches by long threads on the rods, nuts being provided to support the platen from below, and



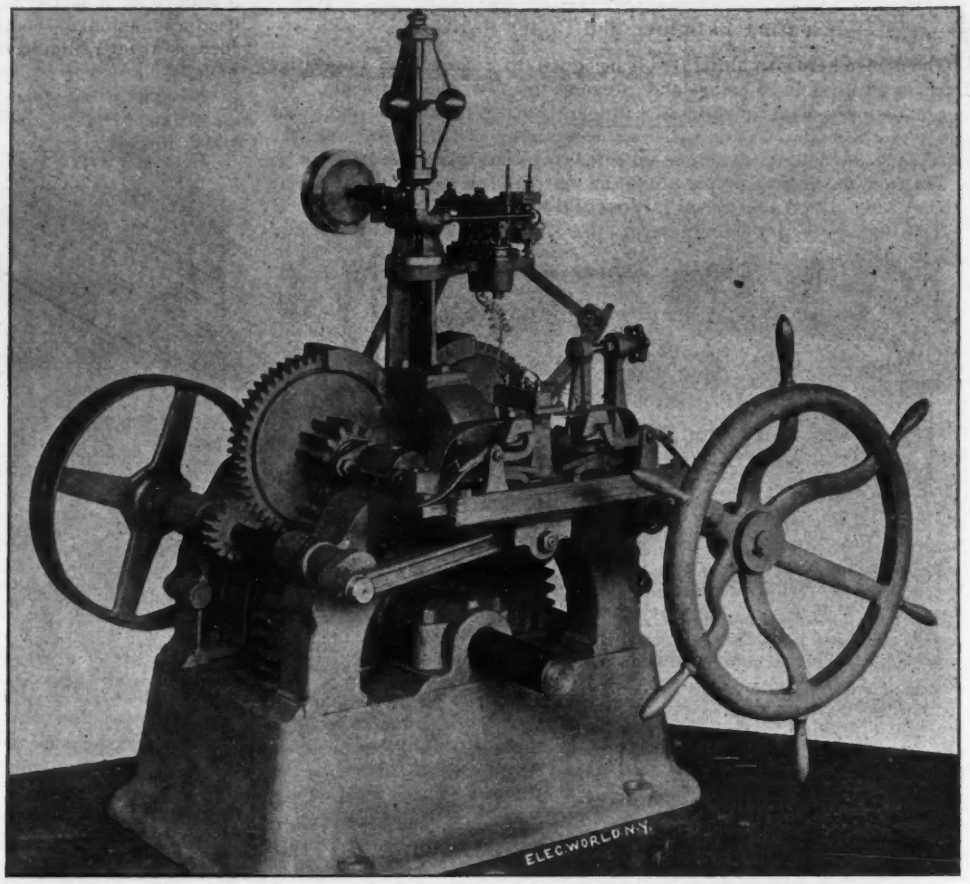
Die Press.

made flush with the surface, while the strain is taken by the nuts and jam nuts above. These presses are furnished in any desired size.

Relay Water-Wheel Governor.

An interesting test was made on April 7 last at Matteawan, N. Y., of a Replogle relay water-wheel governor, manufactured by the Replogle Governor Works, Akron, O.

The time chosen for the test was during a heavy snow storm, with fully three inches of snow on the track, the conditions in general being the most unfavorable. During the 30 minutes' test the circuit-breakers opened 10 times, representing as many instantaneous changes from full load to no load. In only one case did the speed rise to slightly exceed 5 per cent. from the normal.



New Water-Wheel Governor.

The test was conducted on the Citizen's Street Railway, Fishkill-on-Hudson, N. Y., and the results show that in no case did the voltage reach 600 (the normal being 550). In only one case it went below 500. These represent the extreme changes of load, while the variations in speed were only momentary.

The results of this test are considered very favorable for the new wheel.

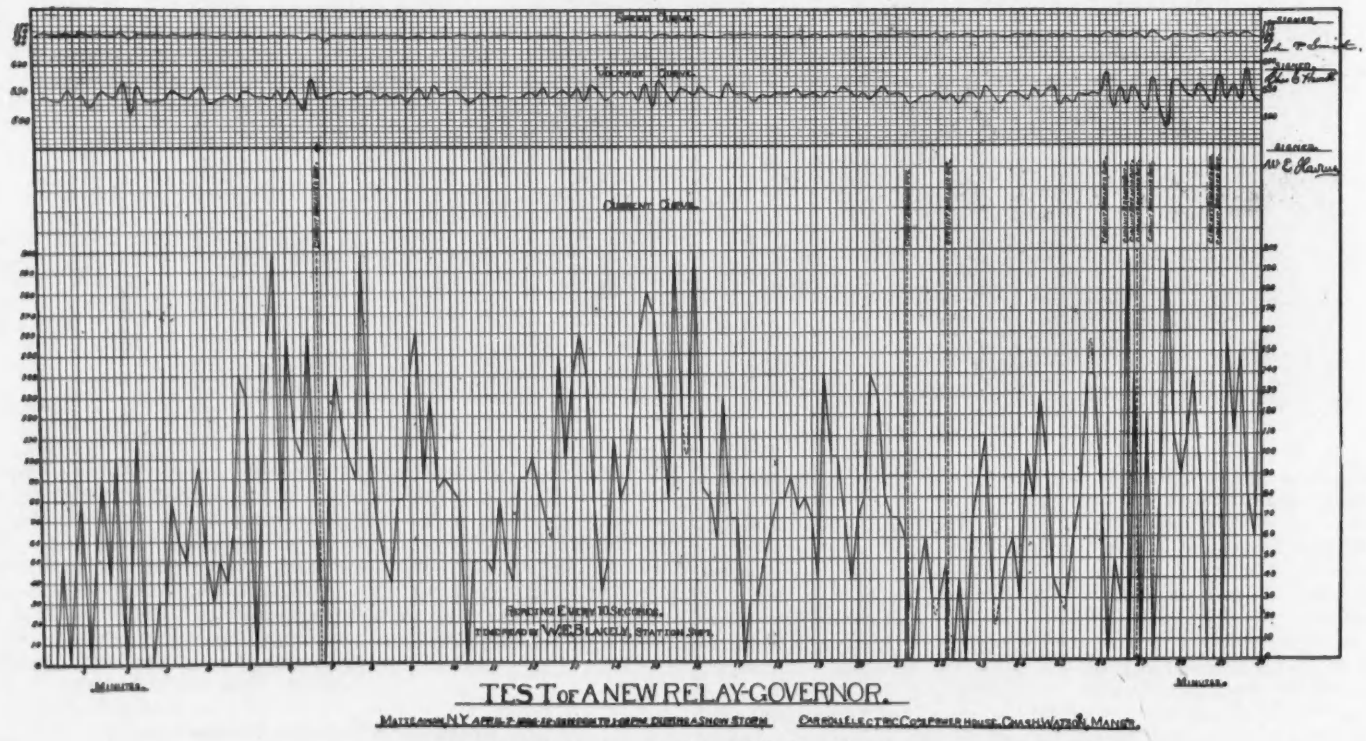


Diagram of Test of Water-Wheel Governor.

The governing of water-power for electric railway work has always been considered a difficult problem, and it was with the object of demonstrating the availability of this wheel for this class of work that this test was made.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, June 6, 1896.

ELECTRICS.—General Electric was rather weak, the net result of the week's trading being one point. Electric Storage Battery common declined three points, although the financial statement issued by the company during the week was regarded rather favorably. The preferred shares also declined, suffering a loss of two points. At the close of the week, however, the two stocks showed greater strength, and prices had an upward tendency.

INCREASE IN WESTINGHOUSE STOCK.—The stockholders of the Westinghouse Electric & Manufacturing Company held a special meeting on June 4 at East Pittsburg and approved of the proposition to increase the company's stock from $10,000,000 to $15,000,000.

TELEGRAPHS.—Telegraph stocks practically held their own during the week, Western Union showing a net gain of ¼, and Postal remaining unchanged from last week.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	118¼	..
Edison Electric Ill., New York	100	96	98
" " " Brooklyn	100	99	102
" " " Boston	100	135	140
" " " Philadelphia	100	137	..
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29½	29¾
Electric Storage, pref	100	31¼	32
General Electric	100	33	33½
General Electric, pref	100	73	75
Westinghouse Consolidated, com	50	..	29½
" " pref	50	52¾	..

BONDS.

Edison Electric Ill., New York	105	107	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	92½	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	204	205
American District Telegraph	100	38	40½
American Telegraph & Cable	100	93	96
Central & South American Telegraph	100	124	127
Commercial Cables	100	150	..
Erie Telephone	100	59½	60
New England Telephone	100	91	..
Postal Telegraph-Cable	100	86	89
Western Union Telegraph	100	85⅜	85⅝

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	18⅛	18⅜
Brooklyn Rapid Transit		24	24⅛
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	68	71
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	43	46
Hestonville	100	53	54
" pref		..	62½
New Orleans Traction	100	11	14
" " pref	100	57	60
North Shore Traction	100	25	27
" " pref	100	77	79
Rochester St. Ry	..	20	25
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	14⅛	14¾
West End, Boston	100	71½	.
" " pref	100	89¼	90
Worcester Traction	100	15½	17
" " pref	100	88	91

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	77	79
Buffalo St. Ry. 1st con. 5s	100	105½	*107½
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	93	97
Rochester St. Ry. 1st 5s	100	99½	102
Union Railway (Huckleberry) 1st mtge 5s		102½	105
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

TRACTIONS.—Trading in street railway securities was characterized by small offerings and an entire absence of demand. This stagnation had the effect of lowering prices a few points in the case of several stocks. Trading in Brooklyn City has practically ceased, owing, it is supposed, to the prevailing uncertainty regarding the suit brought against the company by Mr. Flynn.

DIVIDENDS.—The directors of the West End Street Railway Company, Boston, have declared the regular semi-annual dividend of 4 per cent. on the preferred stock, payable July 1. Transfer books will close on June 13 and reopen June 22.

THE NEW ORLEANS TRACTION RAILWAY reports gross earnings for April of $109,216, a decrease of $1147 as compared with the same month of last year, and net $50,020, a decrease of $1,786.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, June 8, 1896.

THE NEW YORK FIRE DEPARTMENT has recently issued a set of rules governing the installation of electrical apparatus, etc., for electric light, heat and power, the rules being those amended by the Board of Fire Commissioners on April 15, 1896. The rules differ in several respects from those of the National Board of Fire Underwriters.

MICA MINES OF THE WORLD.—The firm of Eugene Munsell & Co., 218 Water Street, New York, miners and importers of mica, inform us that Mr. Franklin Brooks, junior member of the firm, has been away some six months on a business and pleasure trip, including in his itinerary a stay of two months in the mica fields of India. Some idea is gained of the magnitude of these mica fields from the fact that Mr. Brooks traveled about 4000 miles in this section of India alone. As the firm imports mica direct from the mines, the arrangements made by Mr. Brooks places it in a position to supply larger quantities than heretofore to the electrical trade.

WORCESTER NOTES.

WORCESTER, MASS., June 5, 1896.

MESSRS. THOS. SMITH & CO., Worcester, manufacturers of armature discs for dynamos and motors, have already gained a good business foothold in the electrical field. Thos. Smith & Co. is a very old business firm and in the line of die-making and cold-iron punching it has always enjoyed a large and extensive trade.

MESSRS. LINTON & SOUTHWICK, Worcester, manufacturers of switches and switchboards, have succeeded in building up a very nice and satisfactory business, and since the Shawmut Fuse Wire Company, of Boston, has taken the selling agency of its manufactures it has been exceptionally busy in keeping abreast of orders, extending its factory and working force very considerably.

THE COLUMBIA ELECTRIC COMPANY, Worcester, has won for itself creditable distinction and popularity. Its list of installations among the most prominent manufacturing and business establishments at Worcester and Central New England is far better testimony than words of the success it has achieved. While the company has been most busy in the line of construction work, it has at the same time done a good and profitable business in electric supplies, to which it will hereafter give greater attention. The success of this company has been such as to justify its incorporation, which will soon be done under Massachusetts laws. Manager John P. Coghlin and his associate Mr. F. E. Gilbert will continue to exert their well-directed energies for still further success.

MESSRS. WM. ALLEN & SONS, Worcester, who succeeded the Worcester Boiler Works, which has been prominently before the public since 1847, are well known for their business integrity and the high grade of their boiler manufactures and other steam specialties. Important installations in some of the largest power plants in the country, and also in foreign countries, bear strong testimony to the above statement. Such success has attended their work as to secure the wonderful result of 11 pounds of evaporation, by actual tests made by such noted engineers as Prof. Denton, of Stevens Institute of Technology, and Mr. George Barrus, of Boston. The "Victor Feed Water Heater and Purifier" is one of the important specialties of the firm. Their plant is extensive, and covers over one and one-half acres.

THE KENT ELECTRIC MANUFACTURING COMPANY, 27 Hermon Street, Worcester, manufacture dynamos, motors, battery fan motors, alternating-current fans and water meters, its specialty being in the direction of small power and special motors. A small dynamo has recently been brought out by this company applicable for gas engines, doctors, dentists and students, in connection with a small water meter which it manufactures for running small incandescent lamps and motors. It is claimed for the dynamo equal efficiency as a motor for fans, sewing machines and other light power. A dynamo small enough to light a four-cp lamp on a bicycle, and weighing only three pounds, and a new induction motor are its most recent manufactures, the induction motor consuming, it is said, but $3\frac{1}{10}$ amperes at 52 volts, running at a speed of 2000 revolutions per minute, and weighing but 17 pounds.

THE GRATON & KNIGHT MANUFACTURING COMPANY, Worcester, which now holds a leading position in the industrial world as tanners of oak leather and the manufacture of the same into belting, owes its success to a steady purpose of maintaining a high quality of its products. The company of Graton & Knight was established in 1851, and in 1872 was incorporated as the Graton & Knight Manufacturing Company. The company makes belting of any width, ply or weight, and for all purposes where transmission of power is required. The especial feature of the business is the construction of monster belts for electric light, electric railway and large power stations and the numerous installations which have been made argue conclusively in favor of the

electric belts it manufactures. The belts are of one-oak tannage and of selected centre, or "oakbone" stock, hydraulic machinery being utilized for the pressure needed for the successful cementing of the various pieces into one homogeneous whole and mammoth power stretchers to remove all stretch.

Niagara Falls Notes.

Niagara Falls, N. Y., June 4, 1896.

NEW MANUFACTURING PLANT.—The construction of the proposed mammoth plant of the Matthewson Alkali Company will soon be commenced here, and when completed will call for 2000 electrical horse-power. There are rumors of various other concerns locating here, which are not yet definite enough to be given to the public.

THE GENERAL ELECTRIC COMPANY of Schenectady, N. Y., has just completed the installation of a new transformer of 750 horse-power, working at a pressure of 160 volts, at the upper works of the Pittsburg Reduction Company. This is the first of a series of four new transformers which the General Electric will put in. They have carbon brushes and an ironclad armature, the winding being beneath the surface of the core.

AN IMPORTANT CONFERENCE was held at the Cataract House, in this city, Saturday evening last. C. A. Pillsbury, the millionaire miller of Minneapolis, and Hon. Geo. Urban, a prominent and wealthy miller of Buffalo, with legal advisers, had a conference with certain officials of the Cataract Construction Company. It is stated that Mr. Pillsbury came to look over the electrical machinery at the power-house, and that there is in view the erection of a mammoth flouring mill here to be operated by electrical machinery.

CONDUCTIVITY OF ALUMINUM.—The reports of the experts on the conductivity of aluminum wire prepared for the Pittsburg Reduction Company have been made public. Charles F. Scott, chief electrician of the Westinghouse Electric & Manufacturing Company, in his report makes the conductivity from 65 to 66 per cent. of that of pure copper. It is but recently that Lord Kelvin made known the results of his experiments in this same direction. His tests were probably on very pure aluminum and he estimated that it possessed conductivity 70 per cent. that of copper. The Pittsburg Reduction Company has decided to adopt the aluminum wire conductors not only in the new plant on the bank below the Falls but also at the plant above the Falls. The material which the Reduction Company used in these tests was made of the best grade of commercial aluminum containing about ½ of 1 per cent. of alloy.

ENLARGING THE NIAGARA POWER PLANT.—Electrical matters at Niagara have gained quite an impetus from the action of the Cataract Construction Company and Niagara Falls Power Company at the annual meeting of the officers, directors and stockholders. It was decided to extend the present power-house and wheel-pit and install seven 5000-hp electric generators. Most of the power developed by the new generators will be conducted to Buffalo by an overhead transmission cable, where it will be utilized for electric lighting, electric railways and manufacturing purposes, the sale of the power which reaches Buffalo to be controlled by a Buffalo company. A portion of the newly developed power will be reserved for use at Niagara Falls. The contract for the extension of the wheel-pit and power-house has been let to E. D. Smith & Co., of Chicago. The machinery necessary for carrying on the huge undertaking is already on the grounds, and work will begin in a day or two. The contract for the new dynamos was let to the Westinghouse Electric & Manufacturing Company, of Pittsburg, and Mr. L. B. Stillwell, the chief engineer of the company, is now in the city planning the electrical portion of the enterprise.

Western Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., June 4, 1896.

OPENING.—The Michigan Electric Company, Detroit, on the afternoon of June 1, formally opened its new quarters at 101 Woodward Avenue.

REMOVALS.—The Mason Electric Equipment Company, the Fiberite Company and the Lafayette Engineering & Electric Works have moved their offices to 1203 Fisher Building, corner Dearborn and Van Buren Streets, Chicago.

THE MISSOURI TELEPHONE MANUFACTURING COMPANY.—The recent tornado in St. Louis inflicted slight damage upon the factory of the Missouri Telephone Manufacturing Company. The motor circuits were, however, destroyed by the storm, but this does not prevent the company from filling orders with its usual promptness.

THE CENTRAL ELECTRIC COMPANY'S sales of fan motors this season are thus far away ahead of last season's output. This is accounted for by the great popularity of the Lundell fan. The Central Electric Company has a complete line of fans for direct and alternating currents, and for desk or ceiling use. A catalogue will be sent to any address.

ANNUAL CATALOGUE.—The Rose Polytechnic Institute, of Terre Haute, Ind., has just issued its fourteenth annual catalogue, which includes an outline of the course of study and the plan of instruction. At the back of the catalogue is given a complete list of the alumni and different associations of the Institute. Separate pamphlets of the different departments are also issued, giving a description of the courses of each.

"GATES OF CHICAGO" carries a complete line of C. & C. Electric Company's dynamos and motors at his new salesrooms, 311 Dearborn Street, Chicago. Brushes, extra armatures, etc., will be carried for immediate shipment. The C. & C. Company's new motor-starting boxes meet with considerable favor. The motors and dynamos of this company are in constant demand. Mr. Gates will be pleased to see his friends at his new quarters.

CHICAGO ELECTRICAL ASSOCIATION.—The annual dinner of this association was held on the evening of May 29, and was largely attended. The association was organized a few years ago, its object being purely educational its only social function being the annual dinner. Several toasts were humorously responded to and considerable amusement was afforded by alleged talks on the phonograph of Thomas A. Edison, Chauncey Depew, Nikola Tesla and William H. Preece. The officers for the ensuing year are president, W. Clyde Jones; vice-president, S. G. McMeen; secretary, J. R. Cravath; treasurer, F. S. Hickok.

THE SUNBEAM INCANDESCENT LAMP COMPANY, Chicago, has recently furnished its sign lamps for a number of large signs in Chicago, among them being one to the Sterling Cycle Company at the Ferris Wheel park. The representatives of the Sunbeam Company have had a good deal of amusement with electrical engineers and representatives of other lamp companies, in getting them to guess the candle-power. As a rule, the guess is 10 candle-power, sometimes 8 candle-power, and occasionally 16 candle-power, but none of them have judged from the appearance that the lamps were actually but 4 candle-power.

Colorado Notes.

Denver, Col., June 4, 1896.

MINE RAILWAY.—An electric railway to connect the principal mines of the Marshall and Savage basins with a new milling plant, is proposed at Telluride. The principal promoters are David Schwickenheimer, A. J. Clark, and Walter Bearn. It is stated that the main line of the railway will be about two and a half miles in length and lines will extend thence to the several mines.

THE CRIPPLE CREEK DISTRICT RAILWAY COMPANY has been organized to construct an electric railway to encircle the productive mining properties in the Cripple Creek district. The company proposes to carry both passengers and freight. Several franchises have already been granted to the company by towns through which the proposed lines will pass. Senator Fred Lockwood, of Boulder, Col., is interested in the project.

LICENSES FOR CARS.—For months the city authorities of Denver and the Denver Tramway Company have been engaged in a controversy over the payment of license fees for cars. The municipal ordinance provides that the sum of $25 shall be paid for each car. The company has held that the tax should be paid on motor cars only; not on trailers. The authorities have maintained the opinion that the ordinance, if properly construed, required a payment of the fee for every car operated, whether it was equipped with motors or was merely a trailer. After months of discussion a test suit was instituted to recover the fee on one trailer car, and the case was submitted to Police Magistrate Abbott on an agreed statement of facts. His decision, which has just been handed down, is adverse to the company, and judgment for $25 and costs was entered against it. As about 80 trailers are in use in Denver, the decision is one of no little importance to the companies.

ELECTRIC RAILWAY EXTENSION.—It is reported on what appears to be good authority that the Denver, Lakewood & Golden Railway is to be extended from a point three miles north of Golden to the mining district of Idaho Springs, in Clear Creek County. At the present time the line is operated as far as Golden, but electricity furnishes the motive power for only a part of the distance. The cars are run to several suburbs, but those wishing to continue their journey to Golden, 14 miles distant, are transferred to coaches which are drawn by steam locomotives. Electric power is furnished by one of the Denver railway companies, but it has been the general belief that eventually the company would have a power station of its own. The report has it that Mr. Samuel Newhause has secured from Holland capitalists the funds necessary for the construction of the extension. It is said that building will commence within the next few months, as soon as the preliminary work can be finished and contracts let.

INSPECTING TELEPHONE EXCHANGES.—Two representatives of the Japanese Department of Communications have recently devoted considerable time to the inspection of the excellent telephone system of the Colorado Telephone Company. These gentlemen, Rinji Nakayama and Totara Wadachi, were commissioned by the Japanese Government to visit the United States and investigate the latest methods employed in the operation of telephone exchanges. To a representative of The Electrical World they stated that they had reached San Francisco in May, and that they would visit all the large cities in the United States during the next six months. There are at the present time but five telephone exchanges in Japan; the largest is that in Tokyo, where 2000 subscribers are connected to the system. The multiple switchboards of the Western Electric Company are in service. The Government proposes to extend the system on a larger scale and the Imperial Diet has voted to expend $13,000,000 for the purpose. The recommendations of the representatives who are now making their investigations will determine the practice to be followed in the extensions. They have thus far been very cordially received by telephone companies and they speak in the warmest terms of the courtesies which have been extended to them. After they have finished their investigations in the United States they will probably visit for the same purpose, England, France, Germany and other European countries.

General News.

New Incorporations.

THE DUNKIRK ELECTRIC LIGHT & POWER COMPANY, Dunkirk, Ind., has been incorporated with a capital stock of $20,000.

THE CHICAGO SUBURBAN ELECTRIC COMPANY, Chicago, Ill., capital stock, $1,000,000, has been organized by Ralph R. Bradley, Harriet M. Gibbs and Philip S. Post, Jr.

THE LAMARS CITY WATER & LIGHT COMPANY, Le Mars, Ia., has been incorporated by J. F. Rogers, W. J. Rogers and Cora F. Rogers. The capital stock is $150,000.

THE POSTAL TELEGRAPH CABLE COMPANY, San Antonio, Tex., has been formed by George B. Durham, Lowell, Mass.; J. H. McLeary and R. W. Stayton. Capital stock, $300,000.

THE CARNEGIE TELEPHONE COMPANY, Carnegie, Pa., has been incorporated with a capital stock of $10,000. The promoters are Dr. Charles Willis and Dr. Finley B. McGrew.

THE PARAGOULD TELEPHONE COMPANY has been incorporated at Little Rock, Ark., by A. A. Knox, F. Hoffman, M. F. Collier, W. T. Witherington, E. S. Bray and W. G. Collier.

THE NEAL ELECTRIC HEADLIGHT COMPANY, Boston, Mass., capital stock, $10,000, has been incorporated by Franklin E. Huntress, F. A. Huntress, George C. Ewing and George N. Towle.

THE ELECTRICAL MANUFACTURING & SUPPLY COMPANY, Manistee, Mich., has been formed by F. H. Brown, J. O. Nesren, A. J. Dorel and R. W. Smith, Manistee, Mich. Capital stock, $50,000.

THE SALEM LIGHT & TRACTION COMPANY, Salem, Ore., has been incorporated with a capital stock of $100,000 by E. P. McCormack, F. R. Anson, Salem, Ore., F. H. Page and D. S. Tuthill, Portland, Ore.

THE CROUCH MOTOR & TRACTION COMPANY, Portland, Ore., has been incorporated with a capital stock of $100,000. The incorporators are C. E. Seymour, M. S. Hart and Charles P. Church, Portland, Ore.

THE HELENA WATER & ELECTRIC POWER COMPANY has been incorporated at Helena, Mont., by Samuel T. Hauser, Thomas A. Marlow and Barton Sewell. The capital stock of the company is $200,000.

THE WATSON TELEPHONE & TELEGRAPH COMPANY, Chicago, Ill., has been incorporated with a capital stock of $1,000,000. The incorporators are Vernon Cazzard, Evan Humphrey and Herbert S. Schwartz.

THE COLUMBIA & EAU CLAIRE ELECTRIC RAILWAY COMPANY, Columbia, S. C., has been incorporated by F. H. Hyatt, Charles W. McCreery, W. A. Clark, T. T. Moore and others. Capital stock, $50,000.

THE AMERICAN TELEPHONE & TELEGRAPH COMPANY, St. Louis, Mo., has been organized by Edward J. Hall, New Jersey; C. R. Bangs, New York, and George Dana, Kirkwood, Mo. Capital stock, $50,000.

THE MENDOCINO ELECTRIC COMPANY, Mendocino, Cal., has been formed by William A. McCormack, Albert Brown, Charles A. Packard, L. A. Morgan and Joshua Trindle, Mendocino, Cal. Capital stock, $1000.

THE NEW ERA MANUFACTURING COMPANY, Concord, N. H., has been formed by August H. Roby, Malden, Mass.; John P. Thorndyke, N. Woodstock, N. H., and Charles Bridge, Wakefield, Mass. Capital stock, $25,000.

THE E. B. CUTTEN ELECTRICAL & MANUFACTURING COMPANY, Middletown, N. J., has been formed by Charles T. Leonard, Elisha B. Cutten, New York City; Rutsen S. Snyder and Charles H. Snyder, Atlantic Highlands, N. J.

THE SUFFOLK ELECTRIC MANUFACTURING COMPANY, Portland Me., has been organized with a capital stock of $100,000, by Albert N. Reynolds, Dedham, Mass.; Albert W. Rounds, John R. Hammer, A. C. Davies, Boston, Mass.

THE NEW SHARON & NORRIDGEWOCK TELEPHONE COMPANY, Farmington, Me., has been incorporated with a capital stock of $10,000. The incorporators are Henry S. Leeman, of Straks, and Fred C. Hale, of New Sharon.

THE STOCKTON ELECTRIC POWER COMPANY, New York, N. Y., has been incorporated in West Virginia by Frederick A Brown, James Piper, New York City, and William Elder, Chatham, N. J. Capital stock, minimum, $500; maximum, $600,000.

THE BLAKELY RAPID TRANSIT STREET RAILWAY COMPANY, Scranton, Pa., has been organized by W. W. Watkins, Peckville, D. H. Barry and T. W. Spangenburg, for the purpose of building a street railway in Winton, Lackawanna County, Pa. Capital stock, $24,000.

TELEGRAPH AND TELEPHONE.

COLCHESTER, ILL.—Colchester and Macomb will be connected by telephone within 30 days.

JACKSON, MICH.—The Detroit Telephone Construction Company will at once commence work on the building of a plant in this city.

LEBANON, O.—The Miami Telephone Company has been reconstructing its line from this place to Franklin, large poles and copper wire being used.

JACKSON, MISS.—The People's Telephone Company has been organized in this place and promises to give better service at about one half the rates of the Bell Company.

CARTHAGE, MO.—The Western Telephone Company has been re-incorporated, and its lines will be extended to various places in the State, and other improvements introduced.

MACOMB, ILL.—It is understood that J. E. Hall will construct a telephone line between this city and Macomb. The line will be built without a bonus being asked from either place.

MOLINE, ILL.—The Board of Supervisors has granted the petition of the American Telephone & Telegraph Company, of Illinois, to erect poles and wires along the highways of this county.

NATCHEZ, MISS.—Some of the capitalists of Natchez are considering a plan to connect Fayette and a large section of the territory in that vicinity with Natchez by a telephone system.

ROCK ISLAND, ILL.—The American Telephone & Telegraph Company is trying to secure a franchise in this place to introduce the long-distance telephone system in this city and county.

ST. LOUIS, MO.—The Bell Telephone Company's wires along the course of the recent tornado were totally destroyed. Fully 500 poles were broken down and 3500 wires rendered useless. The loss to the company is estimated at about $75,000.

SAN ANTONIO, TEX.—The line between Luling and this place was completed and formally opened recently. This connection places San Antonio in telephonic communication with 31 enterprising towns in South and Southwest Texas.

OBERLIN, O.—The order for telephones and fixtures for the Oberlin telephone exchange and the contract for the construction work have been let and the work is now ready to proceed. The entire system is to be ready for operation within 60 days

TOLEDO, O.—The Central Union Telephone Company is supplying its Toledo subscribers with new and improved long-distance instruments. It is also introducing small electric lights to take the place of indicators at the switchboard in exchanges.

PITTSBURG, PA.—What is said to be the largest contract ever given in the United States for telephones was concluded recently between the Keystone Telephone Company, of this city, and the Atlanta Telephone Company, of Atlanta, Ga. The contract calls for the furnishing of 10,000 telephones at a cost of $300,000.

WARREN, O.—A franchise for a telephone line from Warren to the county line in Bloomfield, has been granted by the County Commissioners to E. E. Howes, of Mesopotamia, A. H. Griffith and Eugene Rawdon, of Windsor, and Hon. E. J. Clapp, of Thompson. The franchise also applies to branches from Bristol and Bloomfield west to the county line.

THE CONSOLIDATED TELEPHONE & TELEGRAPH COMPANY, Providence, R. I., has mortgaged its property for $300,000 in favor of the International Trust Company. The mortgage is made to secure the protection of the stockholders of certain bonds that are to be issued to that amount. The money will be used in the extension of local exchanges in the various towns along the company's lines.

ELECTRIC LIGHT AND POWER.

GRAND MARAIS, MICH.—An electric light plant will soon be installed here.

MAYVILLE, N. Y.—The subject of municipal electric lighting is being considered in this town.

THREE OAKS, MICH.—The Council is investigating the question of establishing an electric light plant

WALLINGFORD, CONN.—The result of the balloting on the electric light question was in favor of the enterprise.

TROY, N. Y.—Gov. Morton has signed the bill providing for the placing of the electric wires in this city underground.

BELLEVILLE, N. J.—The Belleville Township Committee held a special meeting to consider the question of lighting contracts.

ETNA, PA.—The Borough Council has let the contract for a new electric light plant having a capacity of 75 arc lamps for $15,221.

ALAMEDA, CAL.—Judge Frick dissolved the injunction suit against the city, thus allowing it to complete its electric light works.

GEORGETOWN, S. C.—This city will soon be illuminated by electric lights, the contract being already closed for their supply.

CHICAGO, ILL.—The Hammond Lighting Company has declared its intention of increasing its capital stock from $210,000 to $500,000.

FORT WAYNE, IND.—B. S. Tolan has been appointed architect for a new $500,000 Court House for Allen County, to be built in this city.

BAY CITY, MICH.—The Centre Avenue electric light tower, 220 feet high, collapsed in a storm on the evening of May 26, involving a loss of $1500.

DOVER, N. J.—Ground has been purchased by the Electric Light Company on which to erect an electric light plant, and work will be begun shortly.

BRIGHTON, N. Y.—The Brighton trustees have awarded the contract for lighting the village for three years to the Rochester Gas & Electric Company.

STRONGHURST, ILL.—S. W. Carothers has been granted a franchise for an electric light plant in this place. This plant will be the first one in the county.

ORANGE, N. J.—The People's Electric Light & Power Company has just inaugurated a new power circuit. The line will be extended as the requirements demand.

ERIE, PA.—The Finance Committee of Councils held a meeting, and it was decided to ask for bonds to the amount of $60,000 for the construction of a new electric light plant.

MIAMISBURG, O.—The Miamisburg Light & Water Company offers to give the city $10,000 for the plant as it stands, and to furnish arc lights for the next ten years at $80 per lamp.

LAWRENCEBURG, KY.—This city has made a contract with the Standard Engineering Company, of St Louis, for lighting the streets of the town with 15 arc lights of 1200 candle-power each, for a period of eight years, at $1000 a year.

GRUNDY CENTRE, IA.—A franchise has been granted by this town to Dysart parties to light the city by electricity for 12 years. The contract calls for 15 arc lights at $6.66⅔ per month each, and over that number at $5 per month.

HAGERSTOWN, MD.—The City Council granted to Powell Evans the exclusive right for ten years to supply the factories of Hagerstown with electric power. He will erect a 100-hp electric plant in this city and a $150,000 plant at Dam No. 5 on the Potomac river.

PHILADELPHIA, PA.—The Pennsylvania Heat, Light & Power Company has called for an assessment of $20 per share to be paid on the preferred stock as follows: Five dollars per share respectively on June 12, Sept. 10 and Dec. 10, 1896, and $5 per share on March 10, 1897. These calls are made to enable the company to pay for the preferred and common stock of the Electric Trust of Philadelphia in accordance with the recent agreement of purchase.

TOTTENVILLE, S. I., N. Y.—The trustees of the village of Tottenville are considering a plan for lighting the streets by electricity. It is proposed to secure power and have the dynamos erected at the factory of the S. S. White Dental Company at Prince's Bay.

The Electric Railway.

MONTPELIER, VT.—It is probable that a new electric railway will be constructed in Montpelier.

CHAUTAUQUA, N. Y —The proposed electric road from Barcelona to Chautauqua will probably be built.

BROOKLYN, N. Y.—The Atlantic Avenue Railway Company recently paid $60 in fines for violations of the speed ordinance.

HAZLETON, PA.—The citizens of Harwood, Humboldt and vicinity are petitioning for the extension of the traction company's road in that locality.

BRADDOCK, PA.—The Braddock Council has passed finally the ordinance granting a right of way to the Pittsburg, Braddock & McKeesport street railway.

EAST HARTFORD, CONN.—The Central Railway & Electric Company has asked for permission to lay tracks in Stanley, Jubilee and Broad Streets.

LANGHORNE, PA.—At a meeting of the stockholders of the Langhorne Trolley Company it was voted to increase the capital stock from $20,000 to $100,000.

BUFFALO, N. Y.—The Buffalo & Niagara Falls Electric Railway Company proposes to equip 35 cars with motors of 32-hp capacity. Each car will be furnished with four motors of this size.

TAUNTON, MASS.—The managers of the Brockton, Bridgewater & Taunton electric road will ask for permission to extend the line in the direction of Middleboro, and ultimately to New Bedford.

NEW HAVEN, CONN.—The Meriden, Waterbury & Connecticut River Railroad has been purchased by Judge A. Heaton Robertson. It is probable that the road will be equipped with electricity.

BROOKLYN, N. Y.—The gross receipts of the Brooklyn Heights Railway Company for the 11 months ended May 31 were $4,022,016.25, an increase of $277,419.04 over the corresponding period last year.

BALTIMORE, MD.—The Baltimore & Ohio received a third electric locomotive last week. As soon as this is in service all passenger and freight trains will be hauled through the tunnel by electric locomotives.

VICTORIA, B. C.—The Consolidated Electric Railway Company has purchased the electric railway lines in this city that were sold at auction recently. The company is an English syndicate and owns the Nanaimo, Vancouver, New Westminster and Victoria electric railways.

SAN FRANCISCO, CAL.—The Presidio & Ferries Railway (the Union Street cable) has begun converting the Baker Street extension into an electric line. It is said that the horse-car line running on Washington and Jackson Streets will also be changed to an electric line very soon.

TOLEDO, O.—Blair & Co., of New York, who recently purchased for $1,500,000 the Toledo Electric Street Railway Company's lines, have consolidated with the Toledo Traction Company, the chief owners of which are N. B Ream and W. F. Hale of Chicago. It is said a new company, with a capital stock of $5,000,000, will be organized.

BIRMINGHAM, MICH.—It is an odd sight to see cars from the Detroit, Grand Haven & Michigan passing up and down the streets of Birmingham, Mich. The Oakland Electric Railway built a spur and switch connecting with the railway; thus carloads of crushed stone are shunted on the electric tracks and put wherever needed with one handling.

BROOKLYN, N. Y.—As a request of the first week's labor of the new trolley inspectors, 20 suits for violation of the speed ordinance were brought by the city against the various roads. The speed complained of is said to vary from 12 to 22 miles an hour, the Nassau electric road being the defendant in 10 suits and the Brooklyn Heights Company in eight.

PLAINFIELD, N. J.—It is stated that the Plainfield Street Railway Company has made a new contract with the Plainfield Electric Light Company to furnish power for the road for 10 years. The electric light company will increase its power equipment in order to handle the increasing number of cars made necessary by the many railway extensions.

TROLLEY EXPRESS CARS.—The Brooklyn Heights Railway Company will on June 15 place upon its lines six new express cars. Each car will make five trips daily. President Rossiter says that no attempt, as far as he knows, will be made to stop the new trolley service by the regular express companies, and that the express cars will not interfere with the passenger traffic.

ELIZABETH, N. J.—Bids are being secured by the Elizabeth Street Railway Company for the work of laying new tracks, etc., for the changing of the horse car line into an electric road. Estimates are being secured for the power from the Suburban Electric Company and the Consolidated Traction Company. It will cost nearly $100,000 to change the system. It is said that the road will be electrically equipped by the middle of August.

WATERBURY, CONN.—The longest line of steam railway for which an electric equipment has been ordered is the one recently absorbed by the New York & New Haven Railroad Company, which runs from tidewater on the Connecticut River through Meriden to Waterbury, 25 miles long. This road was built chiefly for freight, in which it will differ from other electric roads used for passenger traffic. In this respect it will be a new departure.

FLUSHING, L. I.—The Steinway Electric Railway Company has been endeavoring to secure the right of way through this place to enable it to operate a branch of its system from its present terminus at the eastern end of the village through the Highlands and to the Flushing cemetery. The property owners along the proposed extension state that they will grant the right of way providing a single fare of 5 cents over the entire line is charged with no transfer.

PITTSBURG, PA.—The Westinghouse Electric & Manufacturing Company has completed the equipment of a model train of cars to be used on the elevated railway in New York. It is stated that the Tesla polyphase system of alternating current is applied in this case. When the train is ready for the test the Manhattan railway officials will be invited to witness the same. The test will be made on a branch line of the Pennsylvania railway, several miles of which have been wired and put into shape for the experiment. It is stated that only 210 volts will be necessary to operate the cars.

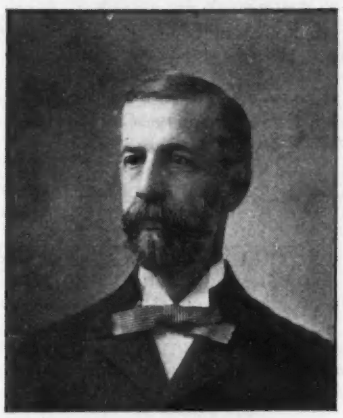
Legal Notes.

MANHATTAN RAILWAY TAXES.—The Appellate Division of the Supreme Court has sustained the Tax Commissioners in their assessment of the property of the Manhattan Railway Company for taxation. The value put upon the property was $16,496,995. The officers of the company thought this assessment was excessive, and asked the courts to review the Commissioners' findings, with the result as above stated.

ST. LOUIS SUBWAYS.—A decision has been handed down by the Supreme Court, of Missouri, sitting *en banc* in the test cases of the St. Louis Underground Service Company against the Street Commissioner of that city, declaring all city ordinances granting corporations the right of way to lay conduits and subways for electric wires or similar purposes void, because the city holds the streets in trust and cannot grant their use for private purposes.

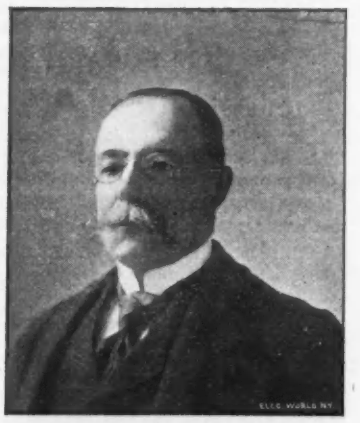
Personal Notes.

MR. H. H. FAIRBANKS, treasurer of the Worcester (Mass.) Electric Light Company, who has made for himself a reputable name in the business and social circles of his own city, and who is well known throughout the electrical fraternity because of his long service on the Executive Committee of the National Electric Light Association, was born in Worcester, and has resided there almost continuously. Favored with an excellent public school education and a graduate from the Worcester Academy, he was well fitted for the successful business career he has experienced. With the exception of four years in Boston in the wholesale boot and shoe business, he has been actively identified with the manufacturing interests of his city, having spent most of his time with the Worcester Corset Company as treasurer. Upon the advent of electric lighting he became interested in the subject, and upon the formation of the Worcester Electric Light Company in 1883, was chosen its treasurer and secretary, which position he still holds.



Mr. H. H. Fairbanks.

MR. W. H. COUGHLIN, superintendent of the Worcester (Mass.) Electric Light Company, is practically a self-made man, and the creditable record he has made is due to extraordinary diligence and unconquerable determination. He was born in Groton, Mass., and attended there the public school and Lawrence Academy, until he was 16, at which age he entered the machinery department of the Ames Plough Company. About two years later he left that company to connect himself with the machinery department of the Bradley Car Company, of Worcester, thence to the Washburn Machine Company, thence to the Worcester, Nashua & Rochester Railway Company, and from there back again to the Washburn Machine Company as master mechanic. Twenty years of his active life were spent in machinery work. Upon the introduction of electric lighting, his attention was at once attracted, and upon the organization of the Worcester Electric Light Company, in 1883, he accepted the position of its superintendent, which position he has held ever since. Mr. Coughlin is a member of the Washburn Engineers of the Worcester Polytechnic Institute and other mechanical and civil engineers' associations.



Mr. W. H. Coughlin.

Trade and Industrial Notes.

MR. A. O. SCHOONMAKER, New York, informs us that he is making a specialty of solid sheet mica washers, and is prepared to furnish any sizes desired and made up to any thickness.

THE BRISTOL COMPANY, Waterbury, Conn., is sending out illustrated pamphlets showing the various types of its recording instruments, especially its recording voltmeter, ammeter and wattmeter.

ELECTRICAL VEHICLES.—The American Electric Vehicle Company, Chicago, has just issued a catalogue descriptive of its electrical vehicles. Carriages of all styles are manufactured and operated by electric power.

"THAT HAMMER BLOW."—The Walker Company, Cleveland, O., has issued a pamphlet entitled "Something About That Hammer Blow, Its Causes, Results and How to Prevent It." The matter is of special interest to electric railway people.

THE RACINE HARDWARE COMPANY, Racine, Wis., manufacturers of vertical and horizontal high-speed automatic engines, etc., has recently sent out a pamphlet of its vertical and horizontal engines adapted to the purpose of electric lighting.

ELECTRICAL MATERIALS.—The H. W. Johns Manufacturing Company, New York, has just issued a neat catalogue illustrating and describing its moulded mica trolley line insulators, sockets, etc., vulcabeston trolley parts, electric car heaters and electrotherms.

MESSRS. BROWN, BOVERI & CO., Baden, Switzerland, and Frankfort-on-the-Main, Germany, have just issued a handsome illustrated catalogue, giving views of the various installations in which their two-phase and three-phase apparatus is now being employed.

THE GLEN FALLS PAPER COMPANY, Glen Falls, N. Y., is making extensive alterations and additions to its plant, and on all its new buildings it is placing roofs supported by steel trusses. The trusses will be furnished by the Berlin Iron Bridge Company, of East Berlin, Conn.

MR. R. W. SCHMELZ, Jacksonville, Fla., has recently sent us a sample of the Vienna soldering flux. As we have no facilities for testing this article, we must refer to the claims made by Mr. Schmelz that it is clean, convenient to handle and non-corrosive and costs much less than soldering salts.

NEW CATALOGUE.—Edwards & Co., manufacturers of electrical specialties, New York, have issued a neat, illustrated catalogue of their manufactures. These include automatic burglar alarms, buzzers, gongs, telephone drops, electric door openers, push buttons, etc. The branch office is at 5 and 7 Dey Street.

THE READING & SOUTHWESTERN STREET RAILWAY COMPANY, of Reading, Pa., will extend its line to Mineral Springs Park. The contract has been let to G. S. W. Brubaker, of Lancaster, Pa., and the works will be completed by July 1.

THE TECHNIC ELECTRICAL WORKS, Philadelphia, reports that it has enlarged facilities for the manufacture of large and complete switchboards for public and private institutions. Among its recent installations are included the University of Pennsylvania, Girard College, the Academy of Music, Philadelphia Iron Works, Homesburg, Tacony & Frankford Railway Company, etc.

WOVEN WIRE DYNAMO BRUSHES.—Mr. W. H. Fleming, patentee of the well-known woven wire dynamo brushes, has made arrangements with Messrs. Stanley & Patterson to act as sole selling agents in the United States for his brushes. With these increased facilities for manufacturing, orders will be filled without delay for any size brush and in any quantity. Stanley & Patterson will keep a large and assorted stock on hand at all times.

Business Notices.

The illustrations in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 1, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

561,107. DOOR LOCK SWITCH FOR ELECTRIC LIGHTS; W. E. Goucher, Jamestown, N. Y. App. filed Jan. 2, 1896. In a door lock switch for electric lights, the combination of a box or case to be secured in the door frame, and having one end open in line with the lock-bolt, spring plates secured at one end within the box or case, and thence extending forward and returned upon themselves, with their extremities normally in contact, an insulated switch-piece lying in the path of the lock-bolt, and having its inner end beveled and adapted to be forced lineally between the contacting ends of the springs when the bolt is projected on locking the door, a spring arm or standard carrying the switch-piece, connections between the switch devices and main line wires and lights in the circuit to be controlled by the movement of the door bolt.

561,116. ELECTRIC SWITCH; F. Land, Syracuse, N. Y. App. filed June 19, 1895. In an electric switch, the combination of pairs of oppositely-fixed terminals, a reversely movable terminal-support, opposite movable terminals secured to the support and formed of greater length than the distance between the adjacent fixed terminals, for simultaneously engaging said fixed terminals, a conducting bar or piece secured to the support and provided with opposite terminals and additional fixed terminals for engaging the terminals of the conducting bar or piece.

561,124. TARGET APPARATUS; J. L. McCullough, Brooklyn, N. Y. App. filed March 13, 1896. In a target apparatus, the combination with a target, a pivoted arm supporting said target, a sliding pin supporting said arm and an electromagnet with its pole adjacent to said pin, whereby the magnet, when excited, will attract and move the pin and allow said arm to fall, of a gun mounted on a universal joint, a generator, an electric circuit including said generator and the magnet at the target, and having in it two breaks, one adapted to be closed by pressure of the trigger of the gun in firing and the other by the aiming of the gun at the target and means for effecting the closure of said breaks.

561,128. TROLLEY SWITCH; M. Rangey and P. Plante, Schenectady, N. Y. App. filed Jan. 17, 1896. In a trolley switch, a switch body provided with uprights at or near each end, two movable rails pivoted to the uprights, but at opposite ends of the frame, each rail being provided with an arm at one end, which extends at right angle to the rail, combined with a spring which has its ends connected to said arms to return the free ends of the rails to position after having been moved by the trolley.

561,144. ALTERNATING ELECTRIC MOTOR; J. A. G. Trudeau, Ottawa, Canada. App. filed July 18, 1894. In an electrometer, the combination of a rotatable armature, stationary energizing coils therefor; stationary field magnets located within the armature, and energizing coils encircling said field magnets, the armature coils and field coils being both connected with a source of electric supply, but in shunt relation to each other.

561,159. FUSIBLE CUT-OUT; L. W. Downes, Providence, R. I. App. filed April 17, 1895. In a safety cut-out, a fuse-wire combined with a tubular sheath of insulating and incombustible material inclosing said fuse-wire and confining a body of air, said sheath having contracted expansible ends.

561,168. TROLLEY STAND; F. N. Kelsey, New Haven, Conn. App. filed March 28, 1895. In a trolley stand, a suitable base adapted to be secured to a car-roof, a table mounted upon said base, and having a swivel connection therewith, a spring-retracted sheath or pulley carried upon said table, a trolley-pole socket-piece pivotally connected to said table, and a flexible connection passing about said sheave or pulley and connected at one end to said socket-piece, and at its opposite end to a rigid support.

561,183. ELECTRIC METER; A. G. Waterhouse, Hartford, Conn. App. filed May 27, 1895. In an electric meter, the combination of a time mechanism, and a register for recording the movements of the time mechanism, with an electromagnet or motor having a movable part, from which motion is imparted to said mechanism and register.

561,204. COMPOSITION FOR EXCITING FLUIDS FOR ELECTRICAL BATTERIES; F. G. Curtis, Philadelphia, Pa. App. filed Feb. 13, 1893. A solution for primary batteries in which the negative element is immersed in a solution of sulphate of aluminum, acetate of lead, hyposulphite of soda, and sulphuric acid.

561,205. POLE PIECE FOR ELECTRICAL BATTERIES; F. G. Curtis, Philadelphia, Pa. App. filed Nov. 20, 1893. A pole-piece for electrical batteries, consisting of a carbon plate having electrically deposited thereon an alloy of copper and tin.

561,274. ELECTRIC SWITCH; H. Ross, Providence, R. I. App. filed Feb. 17, 1896. In an electric switch, the combination with the switchboard and a pair of independent contact-plates secured thereto, and connected with the poles of an electric circuit, of a current-conducting arm or blade capable of being swung into and out of engagement with said contact-plates, as in closing and opening the circuit, and a non-conducting member secured to the blade, having laterally separated sides extending across the blade so as to form a guard or protector.

561,294. ELECTRIC HEATER; H. A. Thomas, Niagara Falls, N. Y. App. filed Feb. 6, 1895. In an electric heater, the combination of a plurality of pipes of insulating material extending parallel with each other, spirals of bare wire wound on said pipes, blocks of porcelain at the ends of the pipes, metal rods passing through the pipes and blocks and secured thereto, said blocks of porcelain being provided with grooves in the edges of the blocks, connection plates in the grooves, a pair of binding screws in each plate connected to the terminals of the spirals, perforations in the blocks, and nuts in said perforations on the ends of one of each pair of screws.

561,307. ELECTRIC RAILWAY; H. Brandenburg, Chicago, Ill. App. filed May 22, 1895. In an electric railway, the combination with conduit-yoke, of cross ties pivotally connected at one end to the yokes, a rail carried at the outer end of the ties and a stringer pivotally connected with and underlying the outer ends of the ties. (See Illustration.)

561,335. TELEPHONE EXCHANGE SYSTEM; K. B. Miller, Wilkensburg, Penn. App. filed Feb. 18, 1896. In a telephone system, divided boards and groups of subscribers' lines, each group terminating in a board, trunk-lines terminating in plugs at both ends, for interconnecting the boards, said plugs being arranged in two sets at each board, and several trunk lines from the plugs of the first set at one board leading to plugs distributed in the second sets of all the boards.

561,358. MICROPHONE; G. W. Sutton, New Rochelle, N. Y. App. filed April 14, 1896. A microphone comprising a diaphragm carrying an electrode, a back supporting an electrode, each of the said electrodes being surrounded by a fabric of a textile character, said electrodes being placed opposite one another with the edges of their surrounding envelopes in contact, whereby a chamber is formed, and comminuted material contained within the chamber.

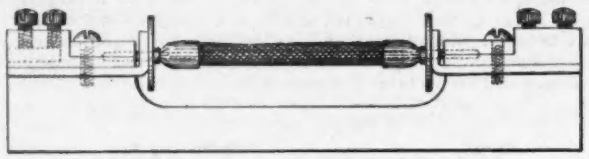
561,377. AUTOMATIC TELEPHONE CALL; G. Q. Dean and J. Dean, Jr., New York, N. Y. App. filed Aug. 3, 1895. A movable contact-maker and contacts actuated by said contact-maker, combined with a movable core, and a detent actuated by and made to engage said core.

561,388. WIRE CONNECTOR; A. Gartner, Newark, N. J. App. filed April 17, 1896. A wire-connector, consisting of a metallic block, provided with a central opening or hole, and with two oppositely arranged openings or

grooves, said central opening and said side openings adapted to receive the wire to be joined.

561,390. DYNAMO ELECTRIC MACHINE; A. I. Gravier, Paris, France. App. filed April 7, 1894 The combination with a core provided with a series of independent coil-sections arranged in diametrically opposite pairs of field magnets provided with recessed pole-pieces, auxiliary coils extending around the upper and lower portions of the armature, and non-magnetic supports for said coils.

561,416. ATTACHMENT FOR TELEPHONES; J. H. Miller, Washington, D. C. App. filed March 12, 1896. An attachment for telephone boxes, consisting of a movable shield, having a hinged strap for attaching the shield to the telephone box by inserting the strap between the door and the edge of the box.



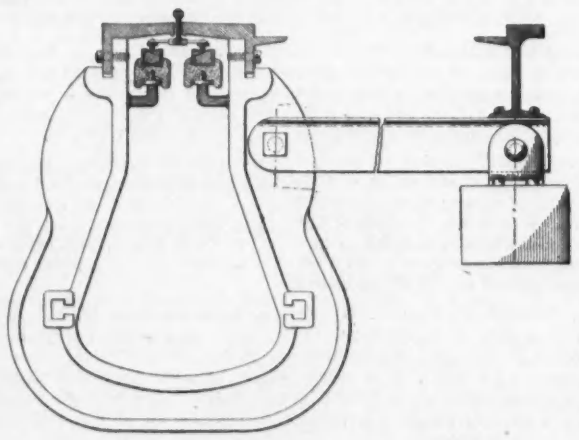
No. 561,159.—Fusible Cut-Out.

561,417. TELEPHONE SYSTEM; P. Minnis, Mobile, Ala. App. filed Feb. 17, 1896. In a telephone system, comprising a series of line stations, a series of independent service wires connecting said line stations with a switchboard at a central station, a single wire common to and in connection with each of the service wires, a tap wire from a single wire to one pole of the main battery, and from the other pole to a spread terminal, connections from said terminal to annunciators at the central station, a series of small talking batteries, one of which is interposed in each of the flexible cords at the central station, and normally open switches at each line station to close the annunciator circuit and the talking circuit, the arrangement being such that the polarity of the talking batteries in the return wire is always the same.

561,418. TELEPHONE EXCHANGE SYSTEM; P. Minnis, Mobile Ala. App. filed Feb. 17, 1896. A series of subscribers' circuits connected to a common return wire, a series of talking sets directly in the line-circuits and talking batteries in loop-cords at the central station, the arrangement being such that the polarity of the several talking batteries in the return wire shall be the same.

561,419. SWITCHBOARD FOR TELEPHONE SYSTEMS; P. Minnis, Mobile, Ala. App. filed Feb. 17, 1896. In a telephone switchboard, the combination with the line jacks and plugs of contacts which complete a circuit for communication between two line stations over service wires and a common return wire, spring contacts arranged in the line-jack and normally closed to form part of a call circuit, and having their ends adapted to be separated by the insertion of the plug, a visual call-signal operated by said circuit, which includes a normally open switch at the line-station corresponding to said jack, and contacts normally separated but electrically connected by the plug to complete a circuit by which the visual signal is restored to its original condition.

561,420. LINE JACK FOR TELEPHONIC SWITCHBOARDS; P. Minnis, Mobile, Ala. App. filed Feb. 17, 1896. A line jack for telephone switchboard, comprising a non-conducting body having an opening for the plug, two separate contacts, two normally closed spring contacts and a single spring contact, all insulated from each other and rigidly attached at one end to the outer face of the non-conducting body, and all entering the opening for the plug in the jack through longitudinal slots in the non-conducting body, in combination with a plug having a metal tip to engage and electrically connect the separated contacts, a non-conducting point to separate the two contacts, and a metallic body having an exposed portion to electrically engage the single contact, and couple it with the wire of the cord.



No. 561,307.—Electric Railway.

561,421. TELEPHONE CALL BOX; P. Minnis, Mobile, Ala. App. filed Feb. 17, 1896. In a telephone, the combination with a casing of a reel journaled therein and having wound thereon the conductors connected with the receiver and transmitter, means for rotating said reel to wind up said conductors, a support for the receiver and transmitter, and mechanism controlled by said support for preventing the reel winding up said conductors when the receiver and transmitter are removed from said support.

561,422. TELEPHONE CALL SIGNAL FOR CENTRAL STATIONS; P. Minnis, Mobile, Ala. App. filed Feb. 17, 1896. A visible call signal for a telephone central station, consisting of a call box having a transparent or translucent front, containing a designation of a line station, an incandescent lamp in said call box, a circuit for said lamp, an electrically operated switch for closing and opening said lamp-circuit, separate circuits for magnets which operate said switch to open and to close said lamp circuit, and automatic mechanical means for maintaining the switch either open or closed.

561,423. TELEPHONE; P. Minnis, Mobile, Ala. App. filed Feb. 17, 1896. A telephone having a receiver and transmitter mounted on opposite ends of a single handle, a normally open palm-switch and a separate, normally open call-operating switch, both arranged in said handle, the former to open and close the transmitting and receiving circuit, and the latter to open and close the circuit of an annunciator at the central office.

561,424. TELEPHONE SWITCH PLUG; P. Minnis, Mobile, Ala. App. filed Feb. 17, 1896. A plug for a telephone switchboard, consisting of an insulating-point having a metallic tip, or extremity, a conducting body portion exposed between the insulating point and an insulating-sleeve covering the remainder of the body portion, a spring-projecting cap longitudinally movable on the end of the insulating sleeve, a contact ring and a bushing in said cap, and wire terminals of flexible cord, one connected to the conducting body and the other to the contact ring, whereby the two wires may be coupled electrically by pushing the cap inward.

561,430. INDICATOR FOR THE SPEED OF REVOLUTION OF PROPELLERS; M. Pfatischer, Philadelphia, Pa. App. filed Aug. 12, 1895 The combination with a ship's propeller shaft or other rotary body, a magneto machine, mechanical operating connections between the said body and the said magneto-machine, and an indicator circuit for the said magneto with a suitable guarded galvanometer included therein to indicate the speed of the said shaft or rotary body.

561,431. TELLTALE FOR STEERING GEAR OF SHIPS; M. Pfatischer, Philadelphia, Pa. App. filed Aug. 12, 1895. In combination with a ship's steering gear and lighting or other electric mains, a resistance introduced between the said mains, a series of contacts respectively connected with different portions of sub-divisions of the said resistance, a single wire circuit and electric telltale connected between one portion of the said resistance and a movable contact, and mechanical connections between the said steering gearing and said movable contact for actuating said contact, the said movable contact being arranged to make contact with the said series of contacts.

No. 561,448.—Magnetic Medical Apparatus.

561,438. WIRE CONNECTOR; D. M. Robertson, Kearney, N. J. App. filed April 17, 1896. A wire connector consisting of two adjoining connecting-channels circular in cross-section and capable of being increased in diameter without losing its circular shape, and adapted to be twisted together with the wires to be jointed.

561,443. ELECTRIC LAMP HANGER; J. Schmidt, New York, N. Y. App. filed Feb. 11, 1896. A crank hanger comprising a rotary spindle, means for rotating the same, a block for supporting the spindle and its rotating means, a cover for attachment to the block and having a slot in its lower side and a tubular carrier movable in said slot.

561,498. PARTY LINE TELEPHONE APPARATUS; W. W. Dean, St. Louis, Mo. App. filed March 28, 1896. A metallic circuit telephone line having two or more subscribers' stations thereon, said line being provided with two limbs adapted to be temporarily united at the central office through branches or extensions thereof, said branches including a retardation coil, a battery being connected at the central office to the centre of said retardation coil, whereby a metallic circuit thus formed is balanced, while voice-currents sent between any two stations on the line are prevented from being shunted.

561,525. SIGNAL BOX; J. J. Ruddick, Newton, Mass. App. filed Sept. 20, 1895. In a signal box, the combination of an escape wheel, pallet therefor, and means for operating said escape wheel, signal pins on the side of said escape wheel arranged in groups and arranged like unto and forming lateral extensions of the teeth of the escape wheel, and a circuit-breaker the movable member of which is operated by said signal pins.

561,526. SIGNAL BOX; J. J. Ruddick, Newton, Mass. App. filed Oct. 9, 1895. The combination with an escape wheel of a counter balance arm, and its arbor, a pallet on said arbor, a spring pressed pallet on an independent arbor, a projection on the first said arbor for lifting said spring pressed pallet and adapted to act thereon when the second said pallet engages the escape wheel, the counter-balanced arm thereby receiving its impulse by the escape wheel acting upon the second said pallet.

561,547. AUTOMATIC TELEGRAPH; S. P. Freir, Hasbrouck, N. J. App. filed Aug. 9, 1893. In an automatic telegraph apparatus for transmitting messages to siphon or equivalent recorders, the combination of a main line transmitting apparatus by which the positive or negative pole of a battery or batteries may be directed to line, and variable pressure main line contacts devices whereby the touch of the fingers in the manual transmission of messages of such character may be reproduced.